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THE ALBERTA BUTTER INDUSTRY: AN ANALYSIS OF LOCATION AND EFFICIENCY

by

HORACE S. BAKER

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The undersigned certify that they have read and recommend to the Faculty of Graduate Studies for acceptance a thesis entitled, "The Alberta Butter Industry: An Analysis of Location and Efficiency," submitted by Horace S. Baker in partial fulfillment of the requirements for the degree of Master of Science.

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ABSTRACT

At present, fifty-two percent of Alberta's milk production is utilized in the manufacture of butter. Alberta produces approximately twice the amount it consumes and is able to sell its surplus on the Vancouver market.

Cream production takes place largely on small diversified farms. Originally a high percentage of cream was handled by cream buying stations. Poor quality of cream and butter resulted from this method of cream procurement and necessitated decentralization of creamery operations. However, the irrational location and multiplicity of creameries caused some operations to operate at very low output, thus rendering them uneconomic units. A subsequent shift in the production pattern from the southwest region of the province to the central and northern regions emphasized the cost-volume problem of the creameries.

In the central and northern regions cooperative creamery associations could control the cream supply areas more rigorously by degrees of monopoly. In the south attempts at cooperation failed with the result that a relatively large number of independently operated creameries still exist. On the average, cooperatively operated creameries manufacture 500,000 pounds more butter per year than independently operated plants. Present day plans of cooperatively organized associations aim at operating fewer plants and obtaining cream from larger supply areas.

An analysis of the manufacturing costs indicated a substantial difference between high and low volume plants. For Alberta creameries

this difference amounted to about 6.37 cents per pound of butter due only to plant costs. Absence of a sufficient volume of cream caused incomplete utilization of equipment and labor.

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CHAPTER I

INTRODUCTION

Butter production is an important aspect of the Alberta Dairy Industry. At present 52 percent of the total annual milk production is utilized in the manufacture of butter. Alberta has a surplus production of butter and is shipping nearly half of its production to the Vancouver market.

Cream production occurs mainly on small-scale, diversified farms. The production pattern of cream has shifted in importance from the southwest region of the Province to the central and northern regions.

A serious cream and butter quality problem in the early twenties resulted in decentralized creameries in closer proximity to the cream supply areas. This improved the quality of cream and butter considerably. However, the economic aspects of operations suffered due to the decentralization of creameries. The result was inadequate supplies of cream for economically sound operations. As a result of the consequent shift in the production pattern of cream from the southern to the northern region several creameries began to operate at relatively low volume.

Analysis of creamery operations was undertaken to find out what the present conditions were and to suggest possible improvements. It was found that there were substantial differences in the per unit cost of manufacturing butter. On the average, for Alberta creameries the difference in manufacturing costs between high and low volume plants was 6.37 cents per pound of butter. This is a substantial difference

and indicates potential savings when the volume of output per creamery is increased. Over the range of plant sizes considered there appeared to be potential savings for all plant sizes by increasing volume.

The cooperative movement among creameries has created two large organizations that have been successful in achieving desired improvements in operations. However, in southern Alberta there remains a relatively large number of independently operated creameries.

Information for this study was obtained from the Dairy Branch staff and statistics, interviews with creamery managers, a questionnaire, and official profit and loss statements of the majority of Alberta creameries (provided confidentially by creamery operators). Some adjustments in the various accounting methods were necessary, but these adjustments did not affect the overall picture to any important extent. It was impossible to include some accounts in the results because the accounting procedures they used prevented integration with other systems. Dairy specialists and creamery managers aided in completing the questionnaires thus providing an excellent service for obtaining more meaningful results.

Moreover, the author paid personal visits to creameries throughout the province and was able to obtain their full cooperation during all the interviews.

The main objectives of the study are a consideration of cost-volume relationship and locational aspects of the creameries. This requires to consider the creamery industry as a whole, in the Province,

in order to yield useful results to the industry.

CHAPTER II

REVIEW OF LITERATURE

Theoretical Review

To obtain a view of any industry, location theory must be considered. Location theory is the theory of determinants of the location of economic activity. Economic activity is the conversion of resources into products for use by consumers. Resources are the starting point for a complicated succession of activities involved in industry. The extent to which location of industry is tied to resources is determined by the extent to which production depends directly on the resources and to the extent it depends on the role of such non-resource considerations such as government regulations and proximity to urban centers.

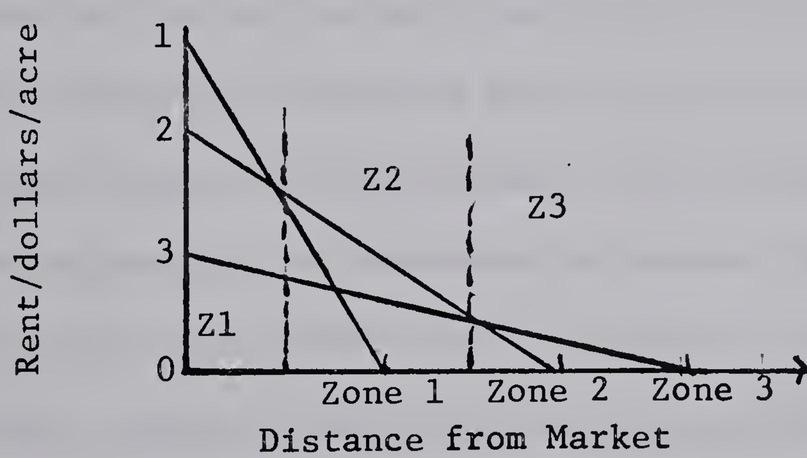
Many scholars have written on location theory. Von Thunen is often regarded as the originator of the theory.[1] Von Thunen sought an answer to "What will be the pattern of land use in the territory surrounding an isolated city market for agricultural products?" He obtained an answer by assuming that costs of production, before rent and transportation cost, were independent of location for every commodity; unit costs of transportation were proportional to distance and independent of direction for every commodity; finally, price at the market of every commodity is given. These assumptions imply that net profitability per acre for any crop--before rent, but after cost of transportation to the market--is a linear function of distance from the

[1] Johann Heinrich Von Thunen, Der Isolierte Staat in Bezienhung auf Landwirtshaft und Nationalokonomie, (Hamburg, 1826).

market. He showed that different forms of land utilization have different distance-price and distance-cost relationships and thus a different relationship between rent and distance from the market for each crop. That linear relationship can be illustrated in a rent-distance diagram with rent declining as distance increases (Figure 1). The use of land that provides the greatest rent will bid the highest for the land and thus displace all other uses. The Von Thunen rings can be drawn using zero as centre and the diameters at the rent level.

FIGURE 1

DETERMINATION OF RENT AND CROP ZONES



Source: "Der Isolierte Staat ..."

Alfred Weber's contribution to location theory was the explicit treatment of the location problem of the individual firm. In Weber's theory the product to be produced is given, and the location of production for an individual firm is to be determined.[1] His approach contrasts with Von Thunen's model, in which the location of the producing unit is given and type of production is to be determined.

The Weber analysis of the location problem of an individual firm producing a single product assumes that there are no geographical variations in the prices of various qualities of inputs as to their alternative sources. Two conclusions can be derived from this assumption: (1) there are no geographic differentials in production costs and (2) the optimum location is the point of minimum transportation costs. If transportation is the only significant factor in the location decision, the firm will select that location with the lowest total cost of transportation. The least-cost location may be at the market point, at the source of raw materials, or somewhere in between, depending upon the characteristics of the product and the production process. Weber recognizes that costs of transportation are not always the decisive factors in firm locational choices. He discusses labor costs and agglomerating factors as well. If geographical variations in wages are present, the labor factor exerts a locational pull. Agglomerating economies and dis-economies accrue to the firm as a result of total industrial concentration at a given location and act to concentrate

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[1]Alfred Weber, Theory of the Location of Industries. Translated by C. J. Friedrich. (Chicago: The University of Chicago Press, 1929).

or disperse the producing units of a given industry intra-regionally. These forces originate in the aggregate size of industrial concentration; they are also apparent in production cost differentials at alternative locations and intensify or counteract the labor-cost pull away from the minimum transportation-cost point. The locational equilibrium of the firm then occurs at the point of minimum cost and implies that there is a single best location for each type of activity.

Hoover provides a more complete analysis of cost factors in location.[1] Cost factors are separated into transportation costs and production costs. Procurement and distribution costs are included in transportation costs, agglomerative forces are included in transportation costs, and agglomerative forces and institutional elements are included with labor as determinants of production costs. The locational choice is a problem of substitution among costs of production and transportation -- the ultimate objective of locational adjustment being the minimization of total outlays. Hoover places more emphasis on realistic characteristics of transport costs then Weber does. He stresses the non-proportionality of transportation rates to distance, the presence of terminal charges independent of length of haul, and the geographic patterns of transportation systems which result from competition among transportation systems. The non-proportionality in transportation rates implies that the marginal cost of a mile is less than the average cost.

[1] Edgar M. Hoover Jr., The Location of Economic Activity. (New York: McGraw-Hill Book Company, Inc., 1948.)

In his "Relation of Individual Location Preferences to the Evolution of Locational Patterns" Hoover discusses the reasons for possible relocation of industry. Some new location may have greater income potential than the older occupied area or site. Does industry move immediately to this newer area, or how does readjustment occur? There may be many obstacles in the way of relocation such as imperfect knowledge, immobility of equipment and persons, and regulations. These factors cause locational adjustment to be sluggish and time-consuming.

The activities of a production enterprise according to Hoover are divided into three stages as follows:[1]

a. Procurement - purchasing and taking the necessary materials and supplies to the site of processing. Production costs, quantity, and distance determine the locational advantages.

b. Processing - transforming the materials into more valuable forms. The prices of factors of production and their substitutability determine the locational advantages for processing.

c. Distribution - selling and delivering of the products. The costs of distribution and the extent of duplication are important.

Processing costs may be reduced by moving to a point with better access to materials. Distribution costs may be lowered by moving to a point with better access to market. These respective forces lead in opposite directions. The advantage to the plant in locating near resources and the final product. For example, sugar beet factories and cottonseed crushing plants are usually located near farms because of the high output of low priced bulky by-products.

[1] *Ibid.*, p. 7.

The proximity of an industry to its markets may be determined by weight gain in the process or by high transfer costs per ton mile of products rather than of materials. Examples are soft drinks and ink. Intermediate points have special transfer advantages when they are trans-shipment points or junctions, and the processing establishment draws from several material sources or sells to several markets.

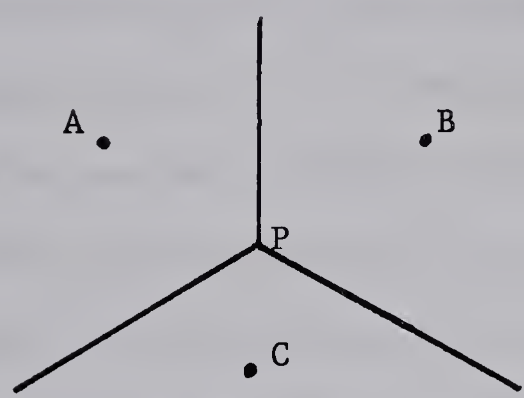
Individual firms competing for materials and markets develop geographic configurations. Market and supply areas may overlap. The locational relation among producers competing for markets is generally one of mutual repulsion as each producer seeks to find a market with the least competition. This competition leads to two-dimensional market and supply areas rather than segments of lines. It is convenient to consider buyers' and sellers' markets individually.

Consider the market areas of three producing centers A, B, and C (Figure 2). The point P is so situated that the transportation costs are the same from all production centers. Each boundary line is defined by the set of points so that transport costs to the two nearest centers are equal. A market center and the boundary have a favored location with respect to all points in the space nearer to it than the points on the boundary lines.

Differences in processing charges of plants result in curved boundary lines. The longer the haul, the greater the curvature (Figure 3). Boundaries are usually blurred by the overlapping of one supply area on the next. Overlapping of areas implies absorption of distribution costs by either the seller, buyer, or transfer agency.

FIGURE 2

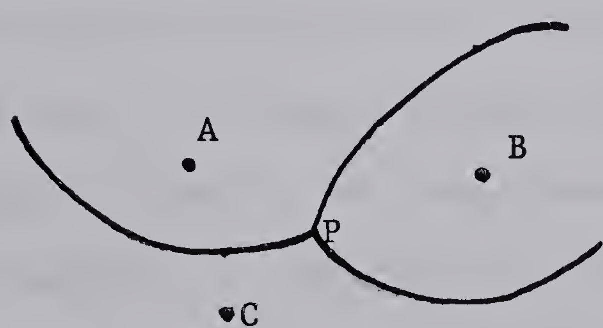
MARKET AREAS OF THREE PRODUCING CENTERS
WITH EQUAL F.O.B. COSTS



Source: The Location of EconomicsActivity, p. 50.

FIGURE 3

MARKET AREAS OF THREE PRODUCING CENTERS
WITH UNEQUAL F.O.B. COSTS



Source: The Location of Economic Activity, p. 51.

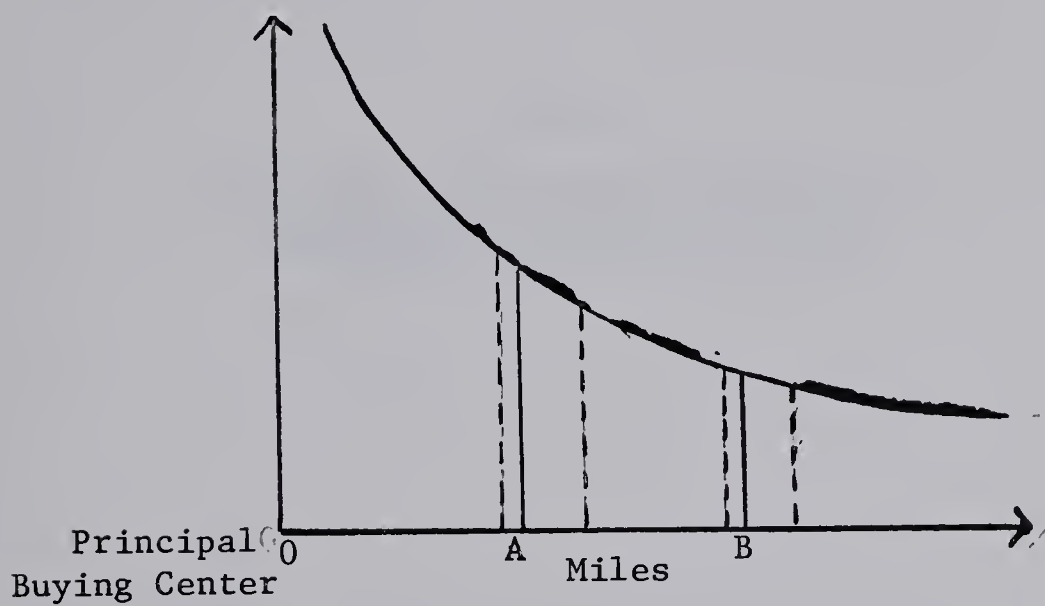
A transfer agency may find it desirable to charge rates that do not increase regularly with distance and thus result in geographical price discrimination. In areas of more intensive competition the transportation charges may be graded down. Prices paid by a processor are more likely to be identical with the prices paid by competitors in areas of high competition than in areas of low competition. One form of freight absorption is the system of uniform delivered prices in which prices extend over broad zones or over the whole range of the market. In a basing point system the delivered prices grade up according to freight costs from some designated point, usually some important producing or distributing center. Supply areas are analogous in the analysis to market areas. The same principles apply at all the successive stages of production.

An interesting complication of this theory is the satellite supply area. Milksheds of small communities may be surrounded by milksheds of larger, more distant communities. Economies of large haul play a significant part in giving small centers their own supply areas when the location of small centers is on a route through which the product passes in transit to a larger buying center. Small farms that are bypassed by trucks hauling to the large center are forced to supply the local market. Suppliers to the right of A and B are able to get the same returns and, therefore, are indifferent to whom they sell (Figure 4). This analysis applies to the principal urban milksheds of the northeastern United States. The New York milkshed surrounds smaller ones, all the way west to Cleveland and north to Rochester.[1]

[1] _Ibid_., p. 63.

FIGURE 4

DELIVERED-PRICE GRADIENT OF A PRODUCT CONSUMED AT A PRINCIPAL BUYING CENTER



Source: <u>The Location of Economic Activity</u>, p. 64.

The location theories outlined by Weber and Hoover are rather similar but with noteworthy differences. Weber assumes that revenue functions are independent of location and that cost is the sole determinant of optimum location.[1] Hoover indicates that every locational adjustment in production means a new relation to markets. Location and demand relationships are not fully developed by Hoover.

Moses illustrates the importance of demand with the aid of a locational model.[2] The production process requires two inputs: raw

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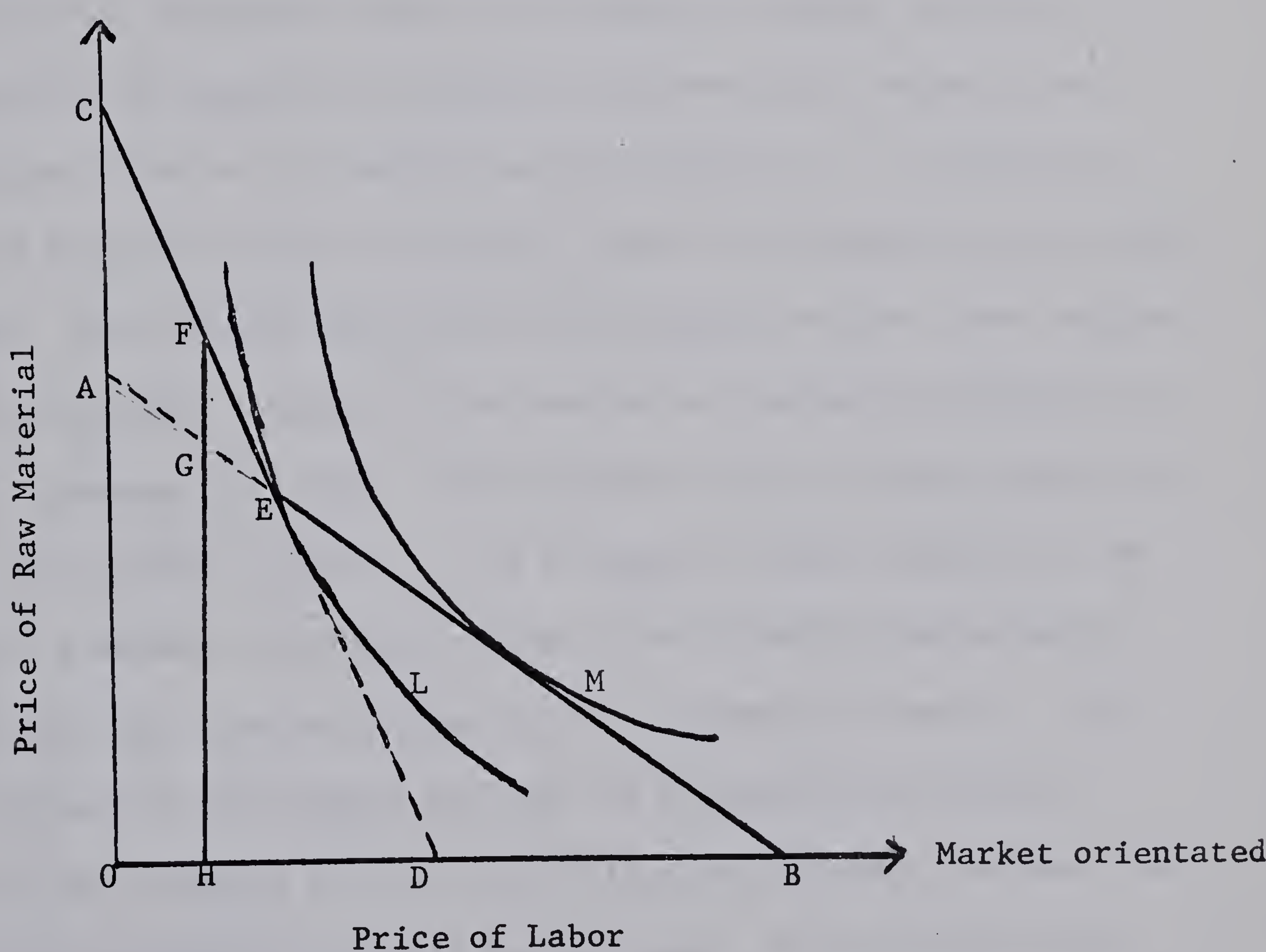
[1]Weber, p. 25.

[2]L. Moses, "Location and Theory of Production," <u>Quarterly Journal of Economics</u>, LXXIII (1958), p. 259.

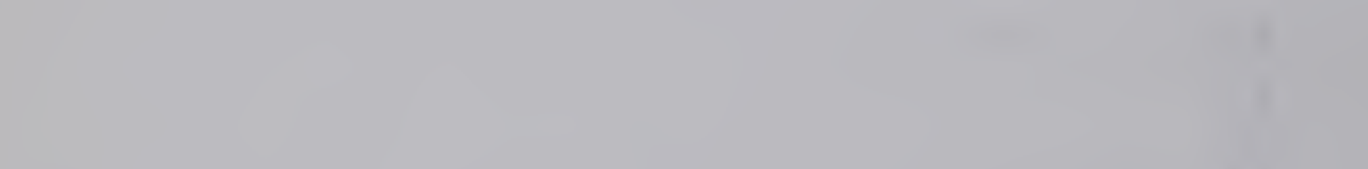
material and labor. Imagine that the price of the raw material is equal to its delivery price plus transportation. Labor is available both at the source of the raw material and the market, but the money price is lower at the market for the identical quality of labor. Thus the iso-outlay lines are straight (Figure 5).

FIGURE 5

ISO-OUTLAY LINES UNDER GEOGRAPHICAL VARIATION IN PRICES OF INPUTS



Source: "Location and Theory...", p. 262.



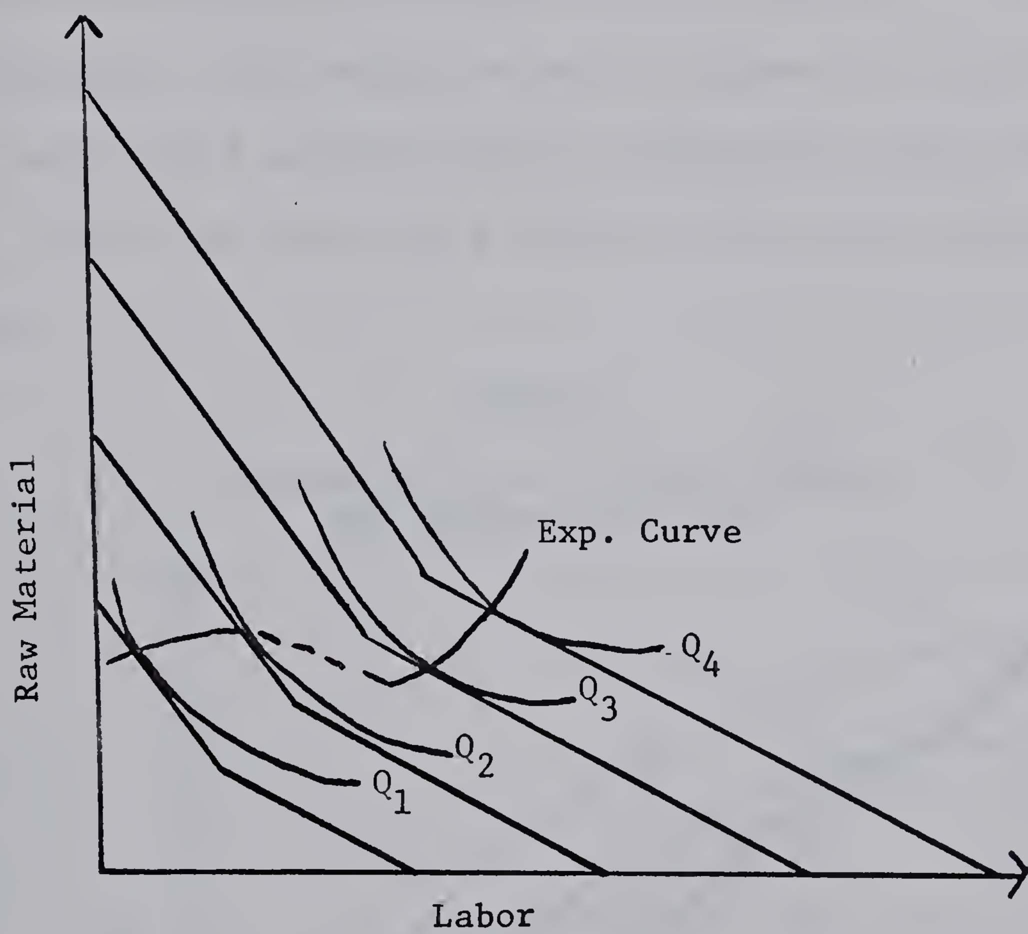
Both iso-outlay lines represent the same total expenditure on the two inputs, taking into account their money prices and transportation on the raw material. The slope of AB is less steep since the price of labor is higher at the raw material source than at the market; the price of raw material is correspondingly lower due to the cost of transportation. The iso-outlay line CD is steeper because at the material source the money price of labor is higher and the delivered price of raw material is lower. Consider now the points G and F, both involving the same expenditure. G lies on the iso-outlay line corresponding to location at the market and F at the material source. If the firm is located at the material source, it will be able to purchase the same quality of labor as formerly purchased, but it can acquire a larger quantity of raw material (HF as compared to HG) with the same total expenditure. This situation holds for all points to the left of E. All points to the right of E indicate that a location close to the market would reduce labor costs. The relevant portions of the curves are CEB. Now suppose that the firm decides to make a total outlay on production expenses of the amount represented by CEB. The isoquants and iso-outlay lines are tangent at two points, L and M. L is a tangency point produced by an isoquant and a segment of the iso-outlay line CD which lies below E, indicating that the firm is located at the raw material source. The firm could locate at the market and use the combination of inputs indicated by the tangency point M, which lies on a higher isoquant than 1, and the total expenditure would be the same. If the price of the product is constant, the profits of the firm will be greater if the firm locates at the market rather than at the material source since

the same total expenditure yields a higher output at the market.

A set of outlay lines and a set of isoquants can be drawn on the same space to illustrate an expansion line (Figure 6).

FIGURE 6

INTERDEPENDENCE OF OUTPUT LOCATION
AND OPTIMUM COMBINATION OF INPUTS



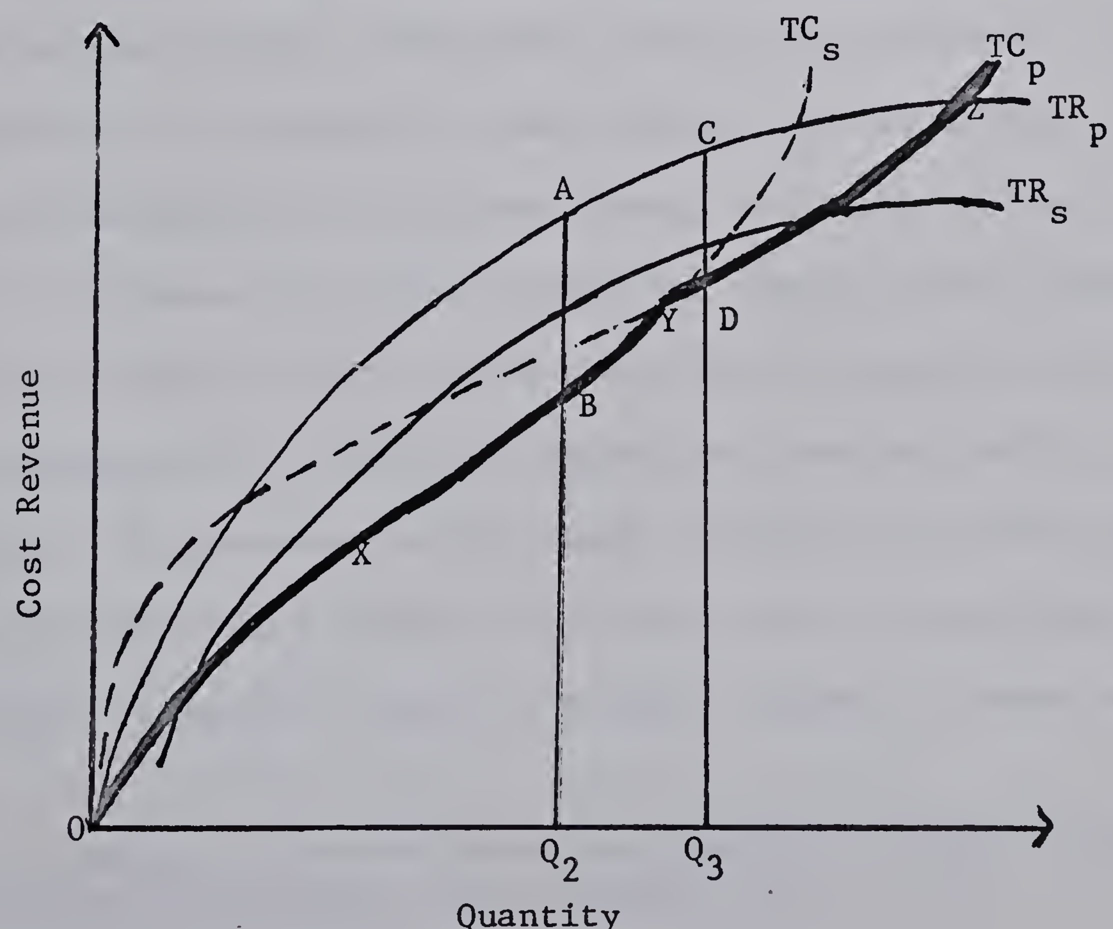
Source: "Location and Theory...", p. 267.

Each point of tangency indicates the best location for producing a given output and the best combination of inputs for producing that output at that location. Location at the raw material source is the optimum location for the firm for outputs up to Q_2 units. For larger outputs location at the market is optimum.

Demand considerations can now be introduced to determine the profit-maximizing output and location of the firm. TC_s is the total cost curve for a firm located at the source of the raw material. TC_p is the cost curve for a firm located at the market. The solid line XYZ corresponds to the expansion path of Figure 7. TR_p is the total revenue curve for a monopolistically-competitive firm located at the market. TR_s is the curve for a similar firm at the source of raw material.

FIGURE 7

DETERMINATION OF OPTIMUM OUTPUT
AND OPTIMUM LOCATION



Source: Location and Theory, p. 269.

If the transportation cost of the product were zero, TR_s and TR_p would be identical, and the firm would maximize its profits (AB) by locating at the raw material source and producing Q_2 units. Since transportation costs are not zero, the firm will maximize its profits (CD) by locating at the market and producing Q_4 units. Thus the optimum location for the firm depends on the base prices of the inputs, transfer costs on inputs and on the product, the production function, and the demand function. A shift in any of the determinants may alter the optimum output and location.

The location theory outlined above has been developed for a region. North argues that "America was exploited in large part as a capitalist venture. Settlement in new regions and their subsequent growth were shaped by the search for and exploitation of goods in demand on world markets."[1] Development of regions based on export differs radically from those which develop gradually from a subsistence level to industrialization. The author cites the development of the Pacific Northwest as an example of development based on exports. This region had not experienced subsistence levels of living but was exploited by the Hudson Bay Company which was engaged in fur trading. After decline of the fur trade, grain and lumber developed rapidly as exportable commodities. Both these commodities were sold mainly on world markets. The relevance of the above discussion to butter plants can be observed from the following historical facts of the Alberta dairy industry. Exports of butter to markets outside of Canada were one

[1] Douglass C. North, "Location Theory and Regional Economics Growth," Journal of Political Economy, LXIII, (June, 1955), p. 243.

million pounds in 1921, two million pounds in 1923, and four million pounds in 1924. The number of creameries, which had declined, jumped from 52 to 100 in the 1921-24 period. Export to world markets from Alberta since 1924 has been minimal, and there has been excess capacity in the creamery industry since that time.

An industry's success in producing an export commodity can be related to the principles of location theory. The demand for the commodity is an exogenous factor to the region, but processing and transportation costs are of regional concern. A reduction in costs increases the economic well-being of the community.

Location theory can be considered in relation to the welfare of society. Least-cost and maximum profit considerations affect chiefly the firm's profitability. The question arises whether society benefits by the policies adopted by the industry. This question is important today because public funds are used to subsidize the dairy industry.

With a simple example William Alonso illustrates that the results of competitive forces in industry do not necessarily coincide with society's aims.[1] Suppose there is a long beach with people distributed evenly along its length. Each person wants an ice cream and want to walk only the shortest distance to obtain it. Consider the problem of two ice cream vendors, A and B (Figure 8).

A will sell to customers to his left and B to those at his right. A decides that by moving to the right he can take away many of

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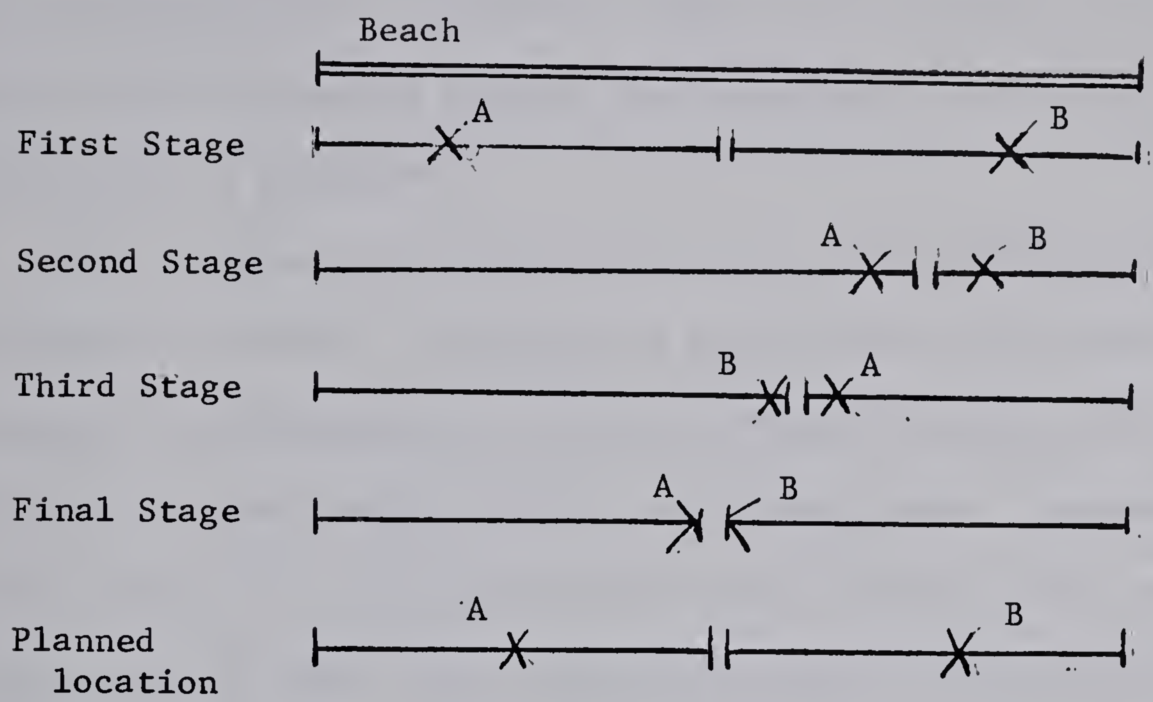
[1]William Alonso, "Location Theory," Regional Development and Planning. Edited by J. Friedmann and W. Alonso. (Cambridge, Massachusetts: The M.I.T. Press, 1964), p. 78.

FIGURE 8

RELATION OF DISTANCE TO ECONOMICS OF PEDDLING



Source: "Location Theory," (see footnote) p. 15.

B's customers without losing any of his own (second stage). Vendor B then decides to move over to the left of A (third stage). In the final stage A and B will be together at the center of the beach, each selling to half the customers. The average distance walked is one-fourth of the length. If the vendors were located at the quarter points, the average distance walked would be reduced to half, while the sales are still the same. Thus the example indicates that the results of imperfect competition may differ from public interest.

Discussion of Location Theory as Related To The Creamery Study

Location theories serve as a framework for the study of the factors determining the location of firms. If the factors involved and the interrelationship between them are clear, the course of action of a firm can be predicted.

The theories developed so far deal mainly with firms handling non-perishable products. Attention is given mainly to economic factors. Von Thunen's rings applied to the dairy industry indicate that the production of cream occurs largely in outlying areas. Accordingly, the seasonal variation in cream production has resulted in the combination of cream with the other farm enterprizes having different seasonal production costs.

Weber's location theory could well be applied to the Alberta dairy industry from 1900-20. The strongly centralized character of the industry indicated that the labor factor exerted a strong locational pull. However, during the twenties the perishable nature of cream dictated relocation of creameries close to the sources of supply. Thus indirect economic forces resulted in a relocation of creameries. The pattern of the twenties is still the pattern of creameries in Alberta today.

Present developments in the dairy industry are, in general, based on economic relationships. The fall in cost of transportation as explained by Hoover is very important in the establishment of larger operating units, the locations of which are largely dependent upon minimization of costs.

The small size of supply areas is a major problem for many plants. Supplies of cream are not sufficient to permit efficient operation, and many non-price procurement practices can be found in the overlapping supply areas. The solution may well lie in a rationalization of the creamery industry so that fewer plants will process larger quantities of cream.

Research Review

Industrial management organizations and governments have continually shown great interest in research related to dairy operations. Studies related to butter and cheese manufacturing have proven to be sources of helpful suggestions for improvement and for future development of the industry.

A study of butter manufacturing in South Dakota indicated that net returns available per pound of butterfat handled were the final measure of the efficiency of a plant and of its desirability as a market for butterfat. Net returns were influenced by factors such as; (1) volume handled, (2) method and cost of procurement, (3) investment and fixed charges in plant, (4) current operating costs, (5) outlets for butter, (6) quality of product, (7) transportation and packaging costs, (8) product sales, and (9) sideline operations.[1] Net returns per pound of butterfat bought varied 4.65 cents between high and low volume plants (Table 1). Plants costs per pound of butter were 3.99 and 2.04 cents for low and high volume plants, respectively.

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[1] W. P. Cotton, et al., Co-operative Creameries in South Dakota, Bulletin 363, Agricultural Experimental Station, South Dakota State College, Brookings, S.D., 1942.

TABLE 1

PLANT COSTS AND PRICE RECEIVED PER POUND OF BUTTER AND NET RETURNS AVAILABLE PER POUND OF FAT OF SOUTH DAKOTA CREAMERIES ARRANGED BY VOLUME - 1941

Pounds of Butterfat Received	No. of Plants	Ave. lbs. B.F. Bought	Plant Costs/ lbs. Butter	Price rec'd/ lbs. Butter	Net Returns Available /lbs. Fat Bought
Less than 150,000	4	129,648	3.99	31.2	33.54
150,000 - 299,999	9	227,973	2.99	32.2	36.48
300,000 - 499,999	5	380,845	2.94	33.1	46.04
500,000 and over	6	759,321	2.04	32.5	38.19

Source: Co-operative Creameries..., p. 22.

Another research bulletin from the same Agricultural Experiment Station related actual production to production capacity per plant.[1] In 1925 the large plants handled 22 percent of the total annual production and in 1950 the increased number of large plants handled 51 percent of the total annual production. The decreasing importance of very large plants was attributed to problems of procurement and quality control in relation to extended cream supply areas. Only one out of 20 plants

[1] Ernest Feder and Sheldon W. Williams. Dairy Marketing in the Northern Great Plains; Its Patterns and Proxpects, Bulletin 438. Agricultural Economics Department, Agricultural Experimental Station, South Dakota State College, Brookings, S.D. 1942.

operated at more than three-fourths of its capacity in June; one-third of the plants operated at less than 25 percent of their estimated capacity. On the average during 1949 capacity utilization of eight plants rated approximately 50 percent.

Haslett found a substantial variation in cheese manufacturing costs among Ontario plants.[1] Factories which produced 25-50 tons of cheese per year had an average cost of 6.8 cents per pound, and factories which produced up to 100 tons of cheese annually manufactured cheese at a minimum of 4.8 cents per pound. There was no clear relationship between cost and size of factory for factories that produced over 100 tons, probably for the reason that transportation costs also rose as the large factories were supplied in part by distant farms (Figure 9).

The Dairy Research Institute of Prague published the results of a report indicating a saving on labor costs after amalgamation of five creamery plants. It was shown that the centralization of butter manufacturing increased labor productivity by 49 percent, with a subsequent reduction in labor costs of 35 percent per ton of output.[2]

Neitzke reported several advantages that a large plant has over a small one: (1) reduction of initial cost per unit of production, (2) easier initial financing, (3) better adjustment of production and distribution to meet market requirements. The slightly increased

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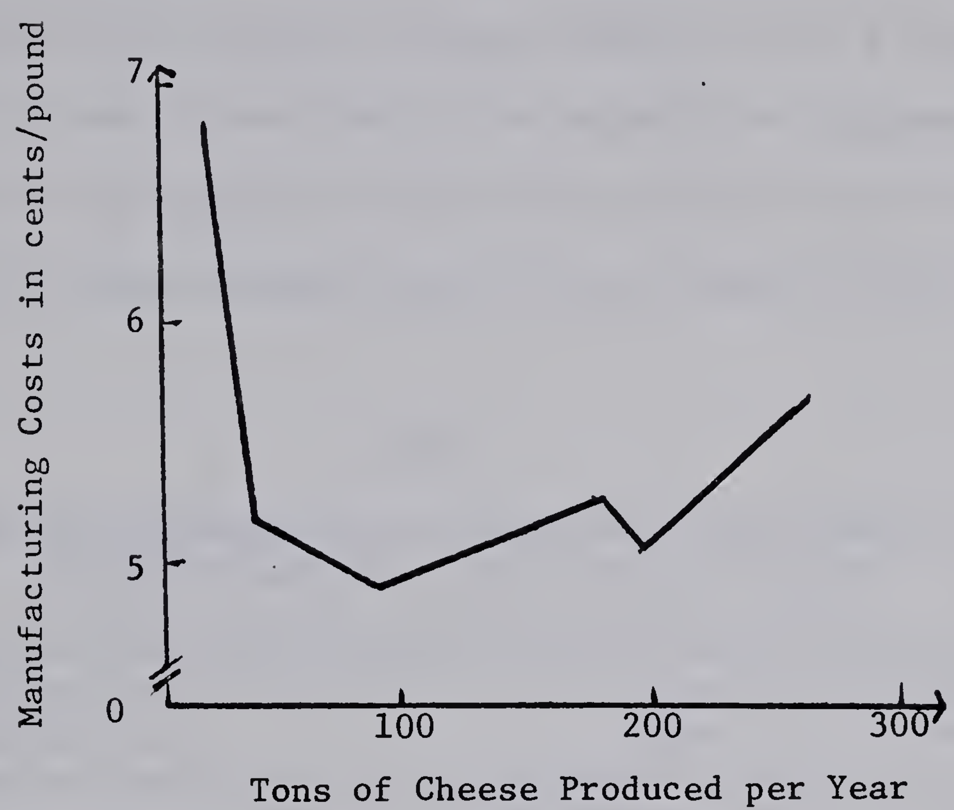
[1] E. A. Haslett, "Cheese Factory Operations in Ontario; An Analysis of Manufacturing Costs," Canadian Dairy and Ice Cream Journal, (April, 1958), p. 30.

[2] B. Sties and A. Prucha, "Study of Labor Requirements in a Regional Butter Factory, 1964," Dairy Science Abstract, XXVII, No. 1 (1965), p. 52.

FIGURE 9

FACTORY SIZE AND MANUFACTURING COST
PER FACTORY OF ONTARIO CHEESE PLANTS, 1955



Source: "Cheese Factory Operations...," p. 30.

transportation requirements usually involved in the expansion of plants had only a slight effect on transport costs. Improvement of the market structure for dairy plants requires that consideration be given to; (1) plant concentration, (2) possibilities of specializing production in the existing plants, (3) amalgamation of several plants into one enterprise. Structural rationalization of large dairying areas should not be left to chance but should rely on long-term projects which allow it to proceed methodically.[1]

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[1] A. Nietzke, "Judging the Scientific Aspects of Dairy Mergers," International Dairy Congress, XVI, 3, (1961), p. 784.

Planned control of the German dairy economy started in 1931 with the reorganization of the existing structure of the industry. Accordingly, rationalization implied the grouping of smaller plants into units and groups of plants in a regional working community with a division of work. Rationalization should continue and be extended as circumstances require. Between 1954-60 the number of dairies was reduced from 544 to 467. The quantity of milk delivered each day rose sharply (Table 2).[1]

TABLE 2

RELATION BETWEEN DAILY DELIVERIES OF MILK AND THE NUMBER OF DAIRIES, WIEN, AUSTRIA, 1954-60

Daily Deliveries of milk in k.g.	Number of Dairies 1954	1960
Less than 5,000	415	323
10,000	46	27
20,000	45	36
40,000	22	50
80,000	12	27
More than 80,000	4	4
Total	544	467

Source: "Rationalization...," p. 851.

Over the past 25 years buttermaking in Sweden has been characterized by considerable rationalization, both in technique and administration. The number of butter-producing plants decreased from 500 in 1941 to about 100 in 1963. Total production changed very little,

[1]Hans Hartle, "Rationalization by a Division of Work," International Dairy Congress XVI, 3, (1962), p. 849.

remaining at approximately 80,000 metric tons annually. The daily production of the average butter factory had shown a corresponding sharp rise from 450 kg. (9 cwt.) in 1941 to 1600 kg. (32 cwt.) in 1963. Some of the bigger factories turned out 30 tons of butter per day in the summer of 1963. Large scale operations resulted in higher butter scores, increased payments to farmers, and lower butterfat content in the butter (Table 3).[1]

TABLE 3

QUALITY AND YIELD OF BUTTER IN THE OSTERLENSMORE AREA, SWEDEN, 1963

Year	Number of Butter Producers	Average Score	Quality Payments (Net S.Dr)*	Fat Content of Butter
1959	12	12.01	- 1,900	82.46
1960	12	12.21	+12,000	-
1961	1	13.03	+68,000	82.12
1962	1	13.15	+86,000	82.08

*One Swedish kroner equals approximately 20 cents

Source: "Centralized Buttermaking...," p. 414.

Many changes in the market structure of the Minnesota dairy manufacturing industry occurred during the past 25 years (Table 4). The trend is toward concentration--fewer and larger plants. The total number of dairy manufacturing plants was 938 in 1938 and 361 in 1963.

[1] Per Swartling and Tage Olsson, "Centralized Buttermaking in Sweden," Dairy Engineering, LXXX, (1963), p. 405.

TABLE 4

NUMBER OF PLANTS IN THE MINNESOTA DAIRY MANUFACTURING INDUSTRY BY TYPE OF PLANT, 1938 and 1963

Type of Plant	1938 Number of Plants	1938 Percent of Total	1963 Number of Plants	1963 Percent of Total
Specialized butter	876	92.4	278	77.0
Butter-powder	7	0.8	55	15.3
Specialized milk drying	0		12	3.3
Cheese	64	6.8	16	4.4
Total	938	100.0	361	100.0

Source: "Creamery Industry...," p. 1.

Buttermaking plants decreased from 867 to 278, they decreased at the rate of 24 per year.[1] In 1963 the four largest plants produced 11.2 percent of the total. In 1938 the four largest plants manufactured 4.8 percent of the total butter in Minnesota. The larger 20 plants produced 32 percent of all the butter in the state in 1963, compared to 13 percent in 1938 (Table 5).[2] Plant managers found that bigger and better equipment when fully utilized, reduced the per-unit cost of output. Another important structural change was the trend toward co-operative ownership. In 1963, 297 of 333, or 84 percent of Minnesota

[1] J. W. Gruebele and E. F. Koller, "Creamery Industry: Structure and Performance," Minnesota Farm Notes, (December, 1965).

[2] Ibid., p. 1.

TABLE 5

PROPORTION OF TOTAL BUTTER MANUFACTURED BY
4, 8, AND 20 LARGEST PLANTS IN MINNESOTA
1938 and 1963

Number of Plants	1938		1963	
	Million Pounds	Percent of Total	Million Pounds	Percent of Total
Largest 4	14.4	4.8	38.0	11.2
Largest 8	23.5	7.8	63.5	18.8
Largest 20	40.5	13.4	108.3	32.0

Source: "Creamery Industry...," p. 1.

butter plants were co-operatives. In 1938, 634 out of 874 plants, or 73 percent were co-operatives. In 1963 the co-operative plants manufactured 91 percent of all the butter in Minnesota; in 1938 they produced only 72 percent.

Operating costs of creameries varied from 10.5 cents per pound to 5.47 cents per pound for plants ranging from 400,000 to 1,500,000 pounds of butter annually (Table 6).[1]

Discussion of Literature Review

The studies reviewed have characteristics in common. They centered around plant efficiency. In the analysis of manufacturing plants emphasis has been placed on volume of product handled. The

[1] J. W. Gruebele and E. F. Koller, "Creamery Industry: Structure and Performance," Minnesota Farm Business Notes, (December, 1965), p. 2.

TABLE 6

AVERAGE OPERATING COSTS FOR 41 BUTTER PLANTS IN MINNESOTA, BY SIZE, 1963

Butterfat Received a year (1,000 pounds)	Number of Plants	Cost per Pound of Butterfat (cents)
100-299	3	10.07
300-499	3	10.50
500-749	6	6.89
750-999	5	6.26
1,000-1,499	18	5.83
1,500 and over	6	5.47
Total or Average	41	6.06

Source: "Creamery Industry...," p. 2.

majority of studies included suggestions for improvement of quality and quantity of the final product by means of technological improvements. Improvements could be effected in the mode of transportation outside and in the equipment used inside the manufacturing plants. Striking results have been reported in both the older and more recent studies. Improvements are either technological in character or improvements of human relations. Technological improvements refer to the efficiency aspects of operating dairy plants. The concern about human relations reflects the fact that many people are involved in the dairy industry. When farmers and processors combine their energies, they are able to achieve better results economically and socially.

Co-operatives in the dairy industry have re-distributed the benefits of operations in part to the producers, thereby strengthening their income position.

CHAPTER III

CHARACTERISTICS OF THE ALBERTA DAIRY INDUSTRY

Climatic conditions and population density determine the extent and importance of dairying in various regions. In 1964 the Alberta dairy industry contributed $41,364,000 to the total farm cash income of the province as a result of the sale of dairy products. (Appendix I, Table 2).

In 1965 the estimated farm value of butterfat for creamery butter was $19,793,000 and constituted 52.1 percent of the total milk production. In the same year the second highest contribution in terms of dollars was made by fluid milk sales. The total farm value of fluid milk sales was $14,055,000 and constituted 17.7 percent of the total milk production (Appendix I, Table 3).

A similar comparison of the value of factory dairy products indicated that the value of creamery butter was $20,084,000 and the value of fluid milk sales (including processing charges) was $18,878,000 (Appendix I, Table 4).

In 1965 total milk production in Alberta was 1,641,221,000 pounds. Of this, 855,551,000 pounds of milk (52.1 percent) were utilized for creamery butter, and 26,653,000 pounds (1.6 percent) were utilized as farm dairy butter.(Appendix I, Table 3).

The amount of milk which is utilized for the manufacture of butter is gradually decreasing. In 1920, 63.7 percent of the total milk production was used for buttermaking purposes. In 1965, 53.7 percent of the milk was used for buttermaking (Table 7). In 1925 an

all time high of 75.1 percent of the total milk produced was diverted to the manufacture of butter. However, at that time increased butter export requirements had caused an unusually high diversion of milk to butter. The manufacture of dairy butter has decreased considerably. Dairy butter amounted to over 20 percent up to 1940. Since then it has decreased to 1.6 percent in 1965. An internal shift from dairy butter to creamery butter caused a considerable increase in the amount of butter manufactured at the creameries.(Table 7).

TABLE 7

UTILIZATION OF MILK FOR BUTTERMAKING IN ALBERTA FROM 1920-65

Year	Percent of Total Milk		
	Creamery Butter	Dairy Butter	Total Butter*
1920	35.9	27.8	63.7
1925	50.6	24.5	75.1
1930	38.5	25.8	64.3
1935	39.1	22.0	61.1
1940	47.6	20.0	67.6
1945	55.6	7.0	62.6
1950	53.2	8.1	61.3
1955	51.0	4.6	55.6
1960	52.9	3.5	56.4
1961	55.6	2.9	58.5
1962	54.6	2.6	57.2
1963	53.2	2.4	55.6
1964	54.2	2.0	56.2
1965	52.1	1.6	53.7

*The columns of creamery and dairy butter have been added together to show the general trend in the utilization of milk for buttermaking.

Source: Dairy Branch Statistics.

Development of the Number of Creameries and the Production per Creamery

Several creameries in the Province started originally as small private enterprises. Many buttermakers seized at some time or other an opportunity to start their own operation. In general, the capital and managerial ability were of limited proportions and implied a great lack of flexibility in relation to adjustment to changing conditions. Several creameries had potential for higher production possibilities in relation to size of building and equipment but had no means to expand their operations successfully by way of reaching out beyond their limited cream supply areas.[1]

From 1920 to 1925 the number of creameries nearly doubled. In 1920 there were 53, and in 1925, 99 creameries.[2] The major cause for this rapid expansion of creameries was the increased demand for Canadian butter on the London market. Alberta's butter export increased from one to four million pounds between 1922 to 1924. Ever since this peak there has been a gradual reduction in the number of creameries in the province. (Figure 10). The relation between the number of plants and the annual production will be discussed in the next section.

Relative Importance of Creameries of Various Sizes

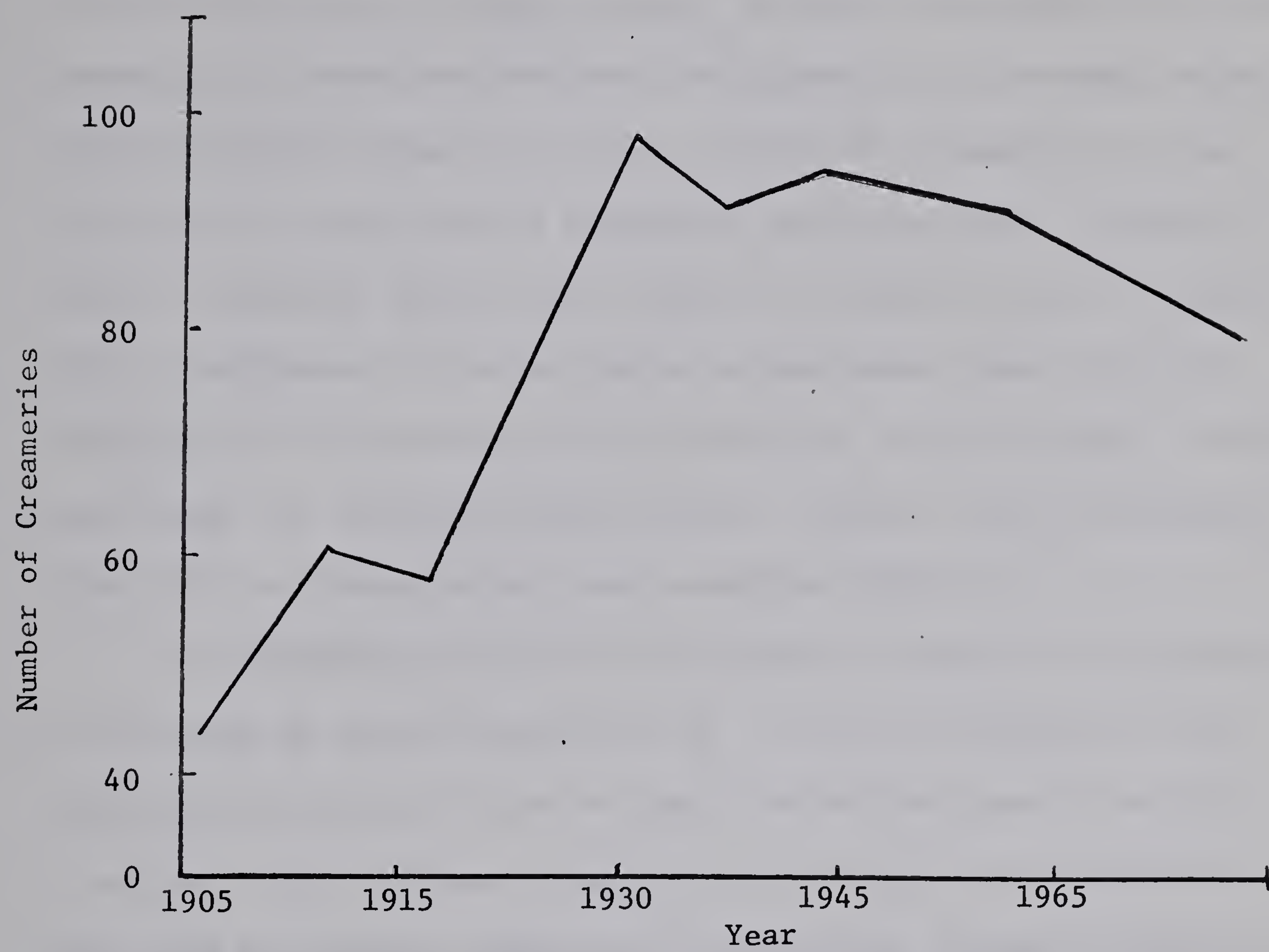
Average production of butter per creamery has been steadily

[1]This general information was obtained from interviews with creamery managers.

[2]In an interview the Dairy Commissioner discussed the irrational locating of some plants in low cream producing areas.

FIGURE 10

NUMBER OF CREAMERIES IN ALBERTA, 1905-65



Source: Dairy Branch Statistics.

increasing over the years. In 1906 average output per creamery was 27,000 pounds of butter.[1] In addition to the above statistics it is useful to consider the relative importance of production by creameries of various sizes.

Creameries vary widely in size, ranging from those manufacturing less than 200,000 to those manufacturing over 1,000,000 pounds of butter per plant per year. Plants in the lower range normally constitute the local plants; those in the higher range, the larger centralized plants.

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[1] Dairy Branch Statistics.

During the development of the industry an increasing share of the butter was made by larger plants. In 1920, 28 percent of the annual production of butter was obtained from plants with an average volume of less than 200,000 pounds per year. In 1965 the creameries in this volume range produced only 6 percent of the total annual production. Several creameries shifted from a lower to a higher range of production. This is particularly true for plants in the lowest range (Table 8). Consequently, the percent of total production in the 200,000 - 400,000 pound range has increased significantly. However, the total number of plants did not change in the same proportion (Table 9).

A substantial increase in the share of production is observed in the range of 600,000 pounds and up. In 1920, 45 percent of the production was obtained from the large centralized plants; in 1930, 14 percent. This decrease coincides with creamery decentralization. Since 1940 the relative importance of the larger creameries (ranging from 600,000 pounds and up) has increased considerably. In 1940 nine percent of the creameries (Table 9) contributed 33 percent to the total output of butter (Table 8), compared with 22 percent of the creameries contributing 52 percent in 1965.

A better overall view of the development of Alberta creameries will be obtained by considering the percentage change in the number of plants in relation to the percentage change in production (Figure 8).[1] The classification of plants by size does not imply that the development occurred only along the suggested lines. Interrelationships as they

[1]The statistics have been calculated from the Dairy Branch records; representation is similar to that in "Dairy Marketing...," in which thirteen states participated.

TABLE 8

TRENDS IN RELATIVE IMPORTANCE OF CREAMERIES OF VARIOUS SIZES
ALBERTA 1920-65

Size of Plant Pounds of Butter	Percent of Production					
	1920	1930	1940	1950	1960	1965
Less than 200,000	28	39	15	11	7	6
200,001 - 400,000	7	29	39	40	27	29
400,001 - 600,000	20	18	13	16	23	13
600,001 - 1,000,000	-	-	14	16	22	26
Over 1,000,000	45	14	19	17	21	26
	100	100	100	100	100	100

Source: Alberta Dairy Branch Statistics.

TABLE 9

TRENDS IN RELATIVE IMPORTANCE OF CREAMERIES OF VARIOUS SIZES
ALBERTA 1920-65

Size of Plant Pounds of Butter	Percent of Plant					
	1920	1930	1940	1950	1960	1965
Less than 200,000	78	69	39	31	24	21
200,001 - 400,000	8	22	42	45	37	44
400,001 - 600,000	6	7	10	13	20	13
600,001 - 1,000,000	-	-	5	9	14	16
Over 1,000,000	8	2	4	2	5	6
	100	100	100	100	100	100

Source: Alberta Dairy Branch Statistics.

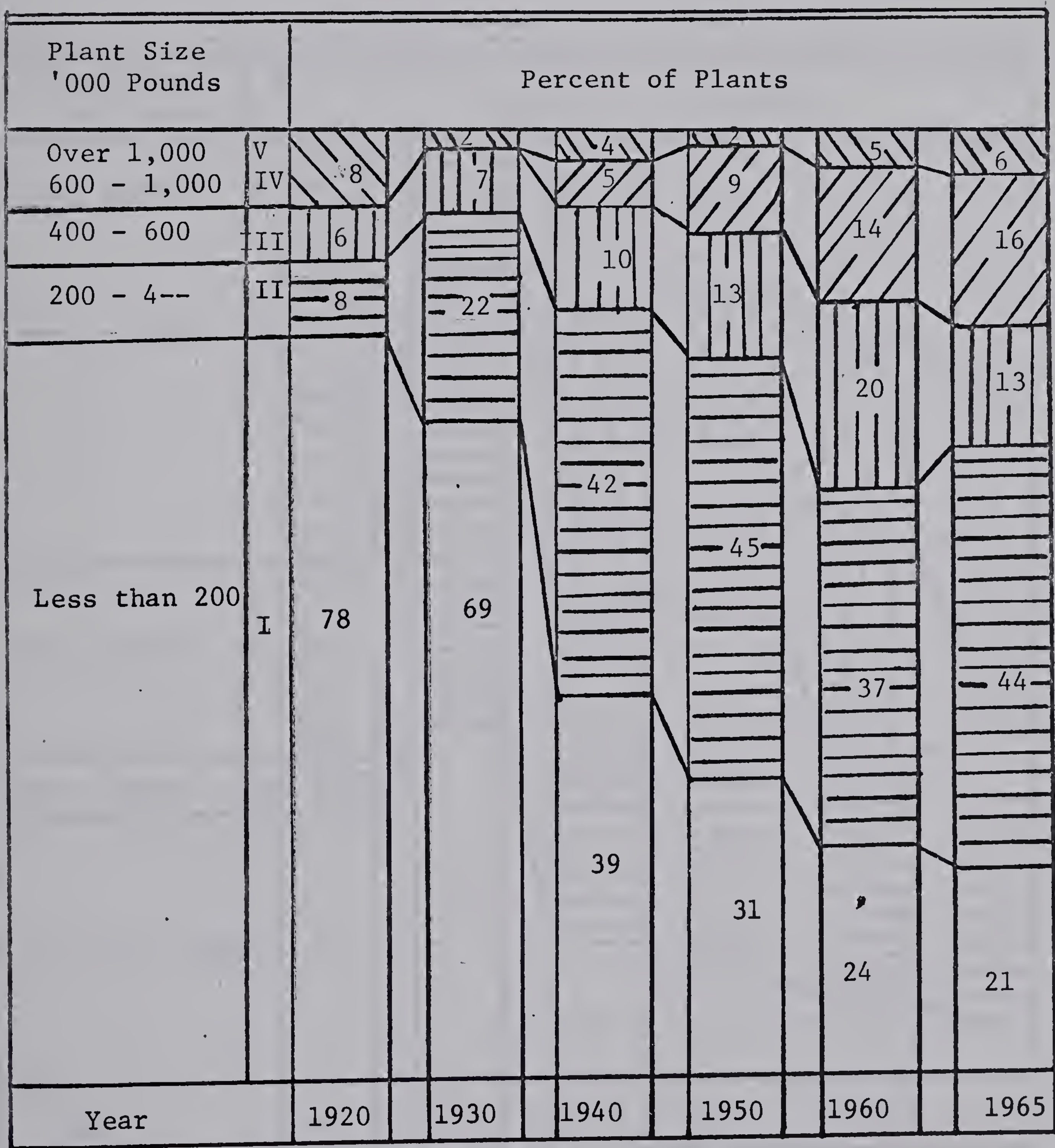
seem to have occurred will be discussed in the following section. It is convenient for discussion to name the various ranges of plant size according to the Roman numerals I, II, III, IV, V, representing the respective plant sizes as indicated in the figures 11 and 12.

Consider first range I, figure 11. The percentage of plants which amounted to 78 percent in 1920 has decreased to 21 percent of the total number of plants in 1965. This not only implies that several plants in range I have increased their annual output and consequently have been reclassified in range II. Production records of creameries showed that smaller creameries and especially cooperatively owned and operated plants have increased average production considerably over the years. At present, average annual production figures of the co-op plants are as much as 500,000 pounds higher than independently operated plants. Thus the decrease of the number of plants in range I and the increase of the number of plants in range II can be explained.

The relative importance of ranges I and II is approximately the same in 1965 as it was in 1940, although their total importance is diminishing. In 1940 ranges I and II represented 81 percent of all the plants and accounted for 54 percent of the total production. In comparison with 1965, ranges I and II represented 65 percent of the number of plants and 35 percent of the total production. However, it can be seen from the figures that since 1960 the sustained number of plants in range II contributed considerably less to the production of butter, which would imply the need for higher volumes of cream to make operations more profitable.

FIGURE 11

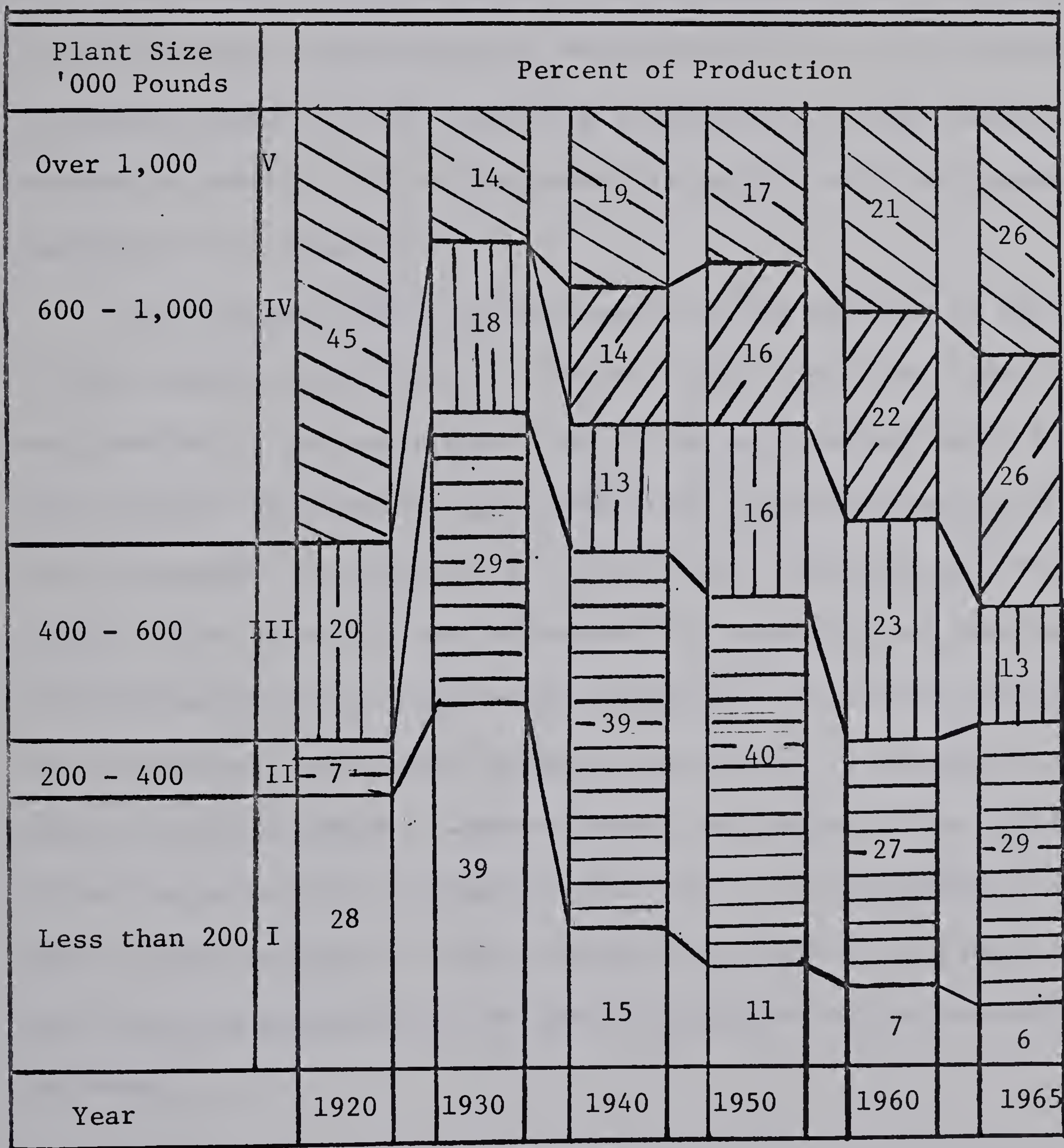
TRENDS IN RELATIVE IMPORTANCE OF CREAMERIES OF VARIOUS SIZES
ALBERTA 1920-65



Source: Alberta Dairy Branch Statistics

FIGURE 12

TRENDS IN RELATIVE IMPORTANCE OF CREAMERIES OF VARIOUS SIZES
ALBERTA 1920-65



Source: Alberta Dairy Branch Statistics.

Ranges III, IV, and V show, in general, the reverse of ranges I and II. The percent of plants and production is generally increasing. However, the number of plants is increasing at a slower rate. The implication is that a smaller number of plants can handle larger outputs. An exception to this pattern can be observed from the figures 11 and 12 during 1920-30 when the decentralization of plants occurred. The overall pattern of the increasing importance of larger plants is expected to continue. Such development is in line with the general expansion of the industry.

An important aspect of development of any industry is the rate at which expansion takes place. Another equally important aspect is the direction of the expansions. During the early development of the dairy industry much emphasis was placed upon the manufacturing facilities' propinquity to the sources of production. Existing problems related to the nature of the product and to transportation resulted in decentralization of the location of creameries. At present the development is directed toward more intensive utilization of equipment at more centrally located plants. Improved roads and transportation facilities provide the potential to accomplish this end. It is necessary to consider the implications of a more intensive utilization of plants in view of the expansion pattern so that this pattern may be evaluated accordingly.

Type and Location of Creameries in Alberta

In 1966 the total number of dairy plants was 110 (Table 10). Thirty-one plants manufactured butter as a specialty product.

TABLE 10

DAIRY MANUFACTURING PLANTS, ALBERTA, 1966

Description of Operation	Number of Plants
Butter	31
Milk*	19
Cheese	8
Ice cream	1
Multiproduct	51
Total	110

*An evaporated and a dry milk plant are included in the 19 milk plants.

Source: Alberta Dairy Branch Statistics, 1966.

An evaporated and a dry milk plant are included in the 19 milk plants. Eight cheese plants include one processed cheese plant. There is one ice cream plant as a single unit. Fifty-one multiproduct plants process milk and cream as raw products into a variety of finished dairy products. Included in the multiproduct plants are 49 that also manufacture butter. Thus the total number of plants manufacturing butter is 80, (31 + 49).[1]

The majority of creameries belong to cooperatively organized associations or dairy pools. The establishment of dairy pools occurred

[1]Creameries include specialty butter plants and plants that manufacture butter as one aspect of their multiproduct operation.

mainly between 1924-30. The Northern Alberta Dairy Pool operates to the north of Ponoka. The Central Alberta Dairy Pool operates south of Ponoka. (Figure 13 map). In 1928 a Southern Alberta Dairy Pool was organized in Calgary. However, this pool operated for one year and was taken over by the C.A.D.P. the following year.

In 1966 Dairy Pools operated 57 percent of the total number of creameries and produced 78 percent of the total annual production. Independent creameries, taken together, operated 43 percent of the plants and produced 22 percent of the total annual production (Table 11).

TABLE 11

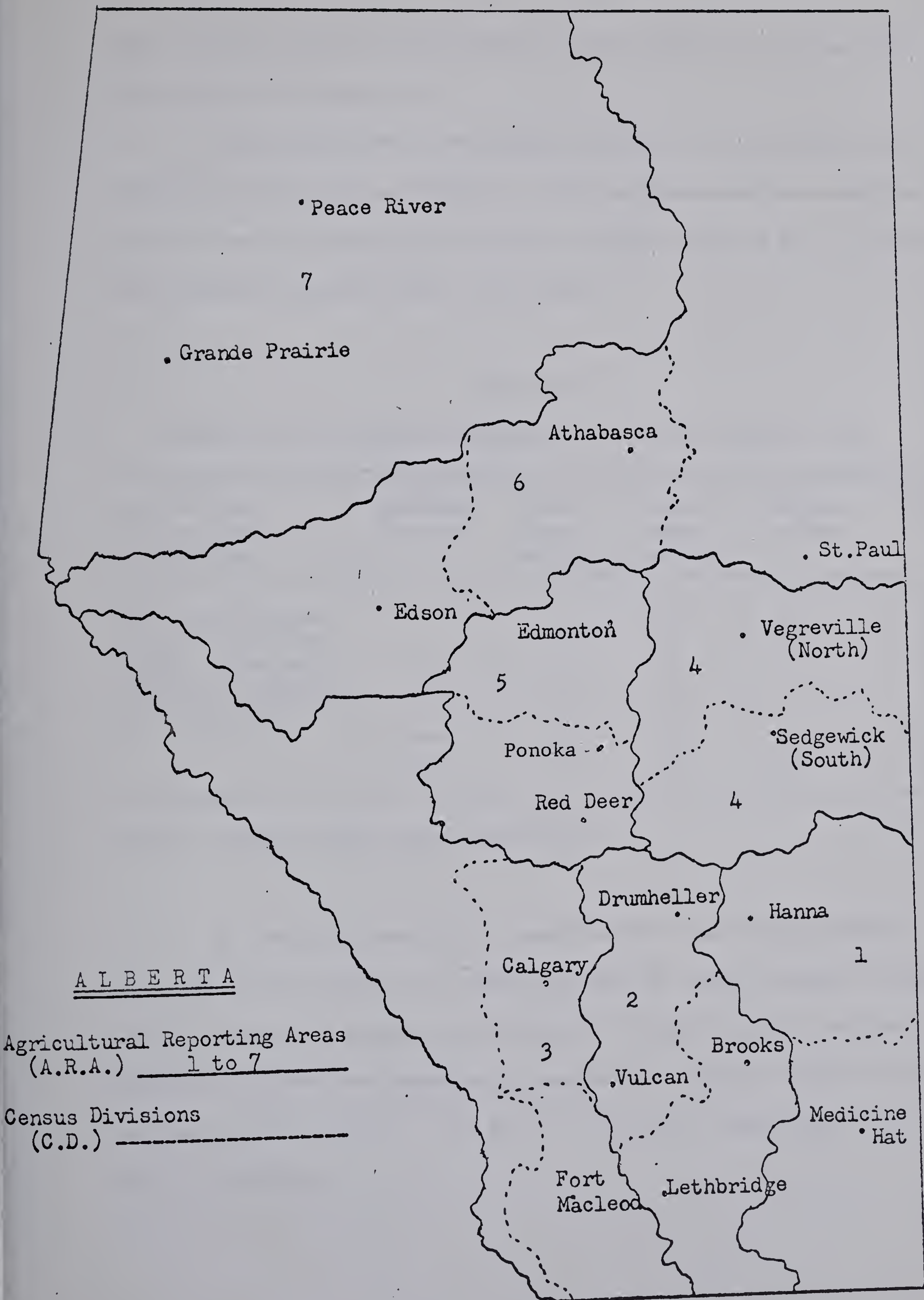
ALBERTA CREAMERIES ARRANGED BY TYPE OF ORGANIZATION, 1966

Type of Organization	Number of Plants	Percent of Total	Percent of Production
Independent (1 plant)	19	24	
Independent (1 to 6 plants)	15	19	22
Cooperatives	46	57	78
	80	100	100

Source: Alberta Dairy Branch Statistics

The Dairy Branch of the Province of Alberta records its statistics in conjunction with the Dominion Bureau of Statistics and the Alberta Bureau of Statistics. The statistics are gathered on the basis of the Census Divisions. To make the statistics more meaningful and comprehensive, the Dairy Branch, as well as other branches of Agriculture,

FIGURE 13


Peace River
7
Grande Prairie
Athabasca
6
St.Paul
Edson
Edmonton
Vegreville
(North)
4
5
Sedgewick
(South)
Ponoka
Red Deer
4
Drumheller
Hanna
1
Calgary
2
Brooks
3
Vulcan
Medicine
Hat
Fort
Macleod
Lethbridge
ALBERTA
Agricultural Reporting Areas
(A.R.A.) 1 to 7
Census Divisions
(C.D.)

have combined several Census Divisions into Agricultural Reporting Areas (A.R.A.) (Figure 13).

The disposition of creameries in Alberta is explained with reference to the A.R.A. (Table 12). The northern section comprises A.R.A. 7 and 6; central west and east, respectively, A.R.A. 5 and 4; the southern section, A.R.A. 3, 2, and 1.

TABLE 12

DISPOSITION OF ALBERTA CREAMERIES BY SIZE AND REGION, 1965

Size of Plant by Volume of Butter (lbs.)	Northern Section	Central West Section	Central East Section	Southern Section	Total
Less than 200,000	3	2	1	11	17
200,001 - 400,000	6	11	6	12	35
400,001 - 600,000	2	3	4	1	10
600,001 - 1,000,000	4	4	4	1	13
Over 1,000,000	1	2	2		5
	16	22	17	25	80

Source: Alberta Dairy Branch Statistics.

Of the total number of creameries (80) the highest number (17 + 35, or 65 percent) of creameries have an annual volume of butter which is below the provincial average of 457,000 pounds of butter. The majority of these low producing creameries are located in the southern section of the province. In A.R.A. 1, 2, 3 are, respectively, 3, 5, and 17 creameries.

Production and Grades of Cream

Total farm acres and the production per acre can be used to indicate the relative intensity of production. The intensity of cream production varies widely from one region to another. The lowest intensity of cream production occurs in A.R.A. 1 with 0.08 pounds of butterfat per acres. A.R.A. 5 has the highest, or 1.81 pounds of butterfat per acre. A.R.A. 6 and 4 have 1.25 and 0.75 pounds of butterfat per acres, respectively (Table 13).[1]

TABLE 13

BUTTERFAT PRODUCTION IN ALBERTA, 1965

A.R.A. No.	Area acres '000	Total farm area '000	Butterfat (lbs.) '000	Butterfat acre	No. of creameries	Average B.F. per plants (lbs. b.f.)
5	7,189	5,239	9,471	1.81	22	430,513
6	45,824	4,951	6,183	1.25	13	467,945
4	10,079	9,255	6,911	0.75	17	406,518
3	17,610	6,302	2,713	0.43	17	159,600
2	8,619	7,982	1,416	0.17	5	283,117
7	59,318	4,341	705	0.16	3	234,941
1	10,594	9,158	753	0.08	3	251,099

Source: Alberta Dairy Branch Statistics.

[1]The use of "Total Farm Area" indicates the actual farming acres and provides a more accurate estimate of the intensity of production than "area acres".

Table 13 has been arranged in order of the relative density of butterfat production per acre. It is abvious from the table that the number of creameries do not correspond highly to the density of production. This is due largely to the fact that the creameries have been established before the more recent production pattern evolved. This point can be illustrated also by rearranging the last two columns of Table 13 in order of increasing "Average Butterfat per Plant" (Table 14). Apart from generalizations it is merely used to illustrate the relative high number of low volume creameries in A.R.A. 3. A second observation may be that a large proportion of the creameries are operating at levels near the provincial average annual production.

TABLE 14

RELATION BETWEEN AVERAGE BUTTERFAT PER PLANT
AND THE NUMBER OF CREAMERIES IN ALBERTA,1966

A.R.A. No.	Average Butterfat per Plant '000 lbs.	Number of Creameries
3	160	17
7	234	3
1	251	3
2	283	5
4	407	17
5	431	22
6	467	13

Source: Alberta Dairy Branch Statistics.

Cream is graded as it arrives at the creameries. Qualified licensed graders determine the grades, governed by a set of established official standards. The major grades are Special Grade, First Grade, and Second Grade. Special and First Grade creams are used for churning First Grade butter (as related to flavour). Some blending of Second Grade cream with a higher grade is possible but not to a large extent, since the quality of the final product becomes easily affected and may subsequently influence the price. Another important problem is the making of a uniform end product. A standardization of cream grades and buttermaking has been a continuous concern to the dairy industry.

In 1922, 27 percent of the cream was graded as Second Grade. At that time the industry shifted from centralized to more decentralized creamery operations. In 1925, 12 percent of the cream was graded as second grade, thereby indicating a substantial improvement in the quality of cream received at the creameries (Appendix I Table 6).

A breakdown of cream receipts at Alberta creameries by A.R.A. indicates that the areas of higher production of cream also have better grades of cream (Table 15). Sixty percent of the cream received in 1965 rated as special; 38 percent rated as first grade. The price of special cream is four cents higher per pound of butterfat than the price of first grade cream. This differential price is set by the Provincial Government and is supposed to reflect quality difference only. Lower prices paid for second grade cream reflect quality differences and transportation costs of this cream since a large proportion of lower grades of butter from this cream finds its way into eastern Canadian markets.

TABLE 15

CREAM RECEIPTS AT ALBERTA CREAMERIES, 1965
(PERCENT OF GRADES)

A.R.A. No.	Special cream	First Grade cream	Second Grade cream	Table cream
1	55.5	43.1	1.4	0.0
2	53.1	44.1	0.8	2.0
3	67.6	31.7	0.6	0.1
4	62.0	36.7	1.3	-
5	62.2	35.5	1.1	1.2
6	57.5	41.1	1.4	-
7	35.6	58.0	6.0	0.4
Total percent	60.3	37.9	1.3	0.5

Source: Alberta Dairy Branch Statistics.

Creameries are able through good blending practices to manufacture 97 percent first grade butter, including butter of 92 score and up. Retail price difference between first and second grade butter is presently 3 cents per pound. The quality of butter is a reflection of the quality of cream received in the various regions and is summarized in the following table.

TABLE 16

ALBERTA BUTTER PRODUCTION AND GRADING, 1965

A.R.A. No.	Percent 93 score and butter	Percent 92 score	Percent second grade	Percent third grade	Total prod. '000 lbs.	No. of cream.	Average/ creamery '000 lbs.
1	30.2	67.7	2.1	-	920	3	307
2	39.9	58.6	1.5	-	1,792	5	358
3	31.2	64.8	3.8	0.2	3,562	17	210
4	60.1	38.9	0.8	0.2	9,475	17	557
5	57.2	37.2	4.7	0.9	12,581	22	572
6	52.4	45.4	2.2	-	7,490	13	576
7	34.9	60.2	4.7	0.2	742	3	247
Total average	52.4	44.3	2.9	0.5	36,562	80	456

Source: Alberta Dairy Branch Statistics.

CHAPTER IV

ORGANIZATION AND OPERATION OF ALBERTA CREAMERIES

Condition of Plants

A consideration of the appearance of plant buildings and their condition or state may not appear to be relevant. However, when the spotlight is turned on efficiency of operations, equipment, volume of output, etc., the condition and value of buildings are important.

On the questionnaires sent to the plants, 39 responded concerning the year of establishment, indicating a definite year. (Table 17). Several plants responded that the date of establishment was no longer known.

TABLE 17

YEAR OF ESTABLISHMENT OF SOME ALBERTA CREAMERIES

Year Built	Number of Creameries
1900 - 1910	5
1911 - 1920	4
1921 - 1930	15
1931 - 1940	3
1941 - 1950	10
1951 - 1960	2
Total	39

Source: Creamery Survey, 1966.

Fifty-one creameries responded to the question concerning type of building. The majority of the buildings consist of a wooden frame structure (Table 18). The outside is usually covered with boards, some have a stucco covering. The inside walls and floors of several of the older buildings are in need of repair and show evidence of patching.

TABLE 18

ALBERTA BUTTER PLANTS ARRANGED BY TYPE OF BUILDING, 1966

Description of building	Number of plants
Frame	34
Cement	7
Brick	7
Concrete block	2
Other	1

Source: Creamery Survey, 1966.

Plant Equipment

In general, equipment should be organized in such a way as to provide a smooth flow of the raw product from the time it enters the plant to the time it is converted into the finished product and sold or stored. A smooth flow implies no severe bottlenecks between plant stages. In order to achieve optimum product flow, it is necessary to harmonize the size or capacity of the equipment in the various stages of production. The law of harmony states that "to minimize the employment of the equipment of the plant, the output of the plant should be

equal to a common denominator of all the capacities of the equipment used in the plant."[1]

An outline of a typical buttermaking operation in a creamery consists of (1) receiving, (2) pasteurizing and holding, (3) churning, (4) packaging and/or printing, and (5) storage. The operation outline does not indicate the time element involved. The usual procedure is to receive cream and pasteurize it on the first day, churn it the second day, and print it on the third day. Although this procedure is typical for local creameries, there are many possible variations that are practiced in the industry. Branch plants of cooperatives often send all or part of their butter in bulk to central printing plants. A modern continuous buttermaking operation in Edmonton can do this operation in one day.

The problem of harmonizing equipment is an individual plant problem and can be solved at the plant level. Survey responses concerning equipment size indicated that at present few problems exist since the volume of cream handled is relatively low thus there are no operational bottlenecks. Some storage facilities seemed hardly adequate if volume were to increase, problems might arise.

As an example of equipment utilization it was decided to consider the churn in greater detail. It was possible to study the churn for 49 creameries which responded adequately. Traditionally creameries used a wooden churn. This type of churn appeared in about 4 discrete sizes. Wooden churns have been largely replaced by stainless steel churns. Of

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[1]H. Brems, "A Discontinuous Cost Function," American Economic Review Vol. 42, (Sept. 1952), p. 580.

49 reports 13 had wooden churns, and 36 had stainless steel churns. The average age of the wooden churn was 20 years. The average age of the stainless steel churn was six years. Thus the changeover is rather recent.

The size of a churning of cream depends on the size of the churn. Buttermakers usually establish a certain amount for their specific churns. This represents, in general, about 80 percent of the rated capacity of the new churn and is based on the buttermaker's experience. Since cream production is subject to seasonal fluctuations, a creamery cannot operate at an average capacity. A plant needs to be equipped to handle the peak production of cream, 12.6 percent of the annual production, which occurs in June (Appendix I Table 5).

It was found that low volume plants underutilize the capacity of their churns. The snapshot result from the survey in 1966 indicates that larger plants more fully utilize the churns. The plants in the largest volume bracket utilize 84 percent of the churns during the peak season (Table 19). For practical reasons it is often necessary to have oversized equipment in plants. Nevertheless, the question remains whether enough consideration has been given to necessary requirements of equipment capacities.

Cream Patrons

The number of cream patrons per creamery is an important factor in the determination of the annual volume per plant. There are very few extremely large shipments from any one patron. In general, the small producer of cream exists in large numbers. Thus it is in the interest

of the creamery operator to have as many patrons as possible. More cream patrons usually implies more cream.

TABLE 19

ESTIMATED AVERAGE UTILIZATION OF CHURNS OF ALBERTA CREAMERIES,1966

Size of Plant '000 lbs. of Butter	No. of Plants	Size of Average Churn	Estimated Capacity*	Average Annual Production	Average June Production**	Percent Used Cap. in June
Under 200	9	750	66,000	122,586	15,446	23
201 - 400	22	1,041	91,608	314,481	39,625	43
401 - 600	8	1,213	106,744	453,456	57,135	54
601 - 800	6	1,517	133,496	673,652	84,880	64
801 - 1,000	2	1,600	140,800	818,360	103,113	73
Over 1,000	2	2,800	246,400	1,639,652	206,596	84

*Estimated capacity is based on size of average churning, four churnings per day; 22 days per month.

**Based on average of Annual Report, 1960-64 @ 12.6 percent of Average Annual Production.

Source: Creamery Survey, 1966.

Of 52 creameries responding to the number of patrons, 19 had less than 300 cream patrons (Table 20). Plants producing less than 400,000 pounds of butter annually had less than 500 cream patrons. Creameries reported that during the winter the number of patrons was reduced by 40 percent.

TABLE 20

RELATION BETWEEN THE NUMBER OF CREAMERIES, CREAM PATRONS AND AVERAGE SHIPMENTS, 1965

Number of Creameries	Number of Shippers	Average Shipment of Butterfat per Patron
19	less than 300	681
18	301 - 500	727
6	501 - 700	751
5	701 - 900	816
1	1,001 - 1,110	797
3	1,201 - 1,300	703
52 Total		

Source: Creamery Survey, 1966.

Some cream is hauled long distances by train, ranging from 50 - 150 miles from the plants. In a typical local creamery situation the majority of cream patrons live between 10 - 20 miles from the plant (Table 21). As distance away from the plant increases, the competition for patrons by other creameries increases.

Seven out of the 43 plants that responded to the delivery of cream by patrons reported 100 percent delivery of cream by patrons. (Table 22). The majority of creameries do some type of cream hauling. Transportation is sometimes provided by the mailman, company trucks, or contract hauling. Transportation costs are often shared between the cream producer and the creamery. Cost sharing originated as a method

TABLE 21

AVERAGE DISTANCE OF PATRONS FROM PLANT IN MILES, 1965

Distance in Miles	Percentage of Patrons
10	35
20	31
30	21
40 and more	13
	100

Source: Creamery Survey, 1966.

TABLE 22

ESTIMATED PERCENTAGE OF CREAM DELIVERED BY PATRONS,1965

Number of Plants	Percentage of Cream Delivered by the Producers Themselves
7	100
10	80
11	60
10	40
5	20
43 Total	

Source: Creamery Survey, 1966.

of semi-price competition to assure the creamery of the patronage of the surrounding area. (This is especially true in the fringe region of the supply area.)

Cream Supply Areas

On the buying side Alberta creameries compete actively for patrons. Of 45 creameries replying to a series of questions on competition, 13 indicated four competing plants in the area. One plant reported eight competing creameries in its supply area (Table 23).

TABLE 23

NUMBER OF COMPETING FIRMS IN ALBERTA CREAM SUPPLY AREAS, 1966

Number of Plants	Number of Competitors
5	1
4	2
11	3
13	4
9	5
2	6
1	8
43 Total	

Source: Creamery Survey, 1966.

Creamery managers belonging to the same co-operative often compete against each other for patrons. Dairy co-operatives have been very successful in their competition for patrons. The buying-out of several creameries has eliminated potential competition and expanded the supply areas. Redistribution of pooled profits to the member patrons has provided an additional incentive for prospective cream shippers to join pools and by-pass independently operated creameries.

Cream supply areas are often partly or completely overlapping. This implies that extra money is spent on transportation. City plants obtain their cream from totally overlapping supply areas. Country creameries often have their own supply area with the fringes overlapping areas of other creameries. If cream shipping is to be maintained, possibly transportation costs could be reduced by regulations preventing unnecessary extra costs of transportation.

Manufacturing Costs of Butter

Not only was information obtained from the questionnaires directly, but also quantities from official plant operating statements.[1] Integration of the various bookkeeping systems necessitated that three plants be eliminated. In some cases items were grouped to accommodate integration and obtain a general overall view. In calculating as many records as possible were included; however, it was sometimes necessary to leave out a few records because the results were impossible to

[1] Profit and loss statements of creameries were obtained and average figures used in providing general information.

justify when these records were included.

It was found that the cost per pound of butter differed substantially between low and high volume operations (Table 24).

TABLE 24

AVERAGE COST AND PROFIT MARGIN FOR ALBERTA CREAMERY OPERATIONS (cents),1966

Size of Plants (pounds of butter)	Cost of Butterfat in Butter (1)	Total Cost per Pounds of Butter (2)	Plant Cost per Pound (2-1)	Sales (4)	Margin of Profit (4-2)
Under 200,000	43.06	54.33	11.27	52.36	-1.97
200,000-400,000	42.52	49.82	7.30	52.07	2.25
400,001-600,000	40.45	49.28	8.83	53.78	4.50
600,001-800,000	41.64	47.58	5.94	52.16	4.58
800,001-1,000,000	41.32	47.09	5.77	51.90	4.81
Over 1,000,000	41.29	46.19	4.90	51.69	5.50

Source: Creamery Survey, 1966.

Column (1) represents the cost of butterfat to the creamery. The figures include the price paid for the various qualities of cream. Column (2) represents the total cost per pound of butter. The difference between column 2 and 1 represents the plant costs per pound of butter, or actual manufacturing costs. Sales are represented in column (4) and the profit margin in the last column.

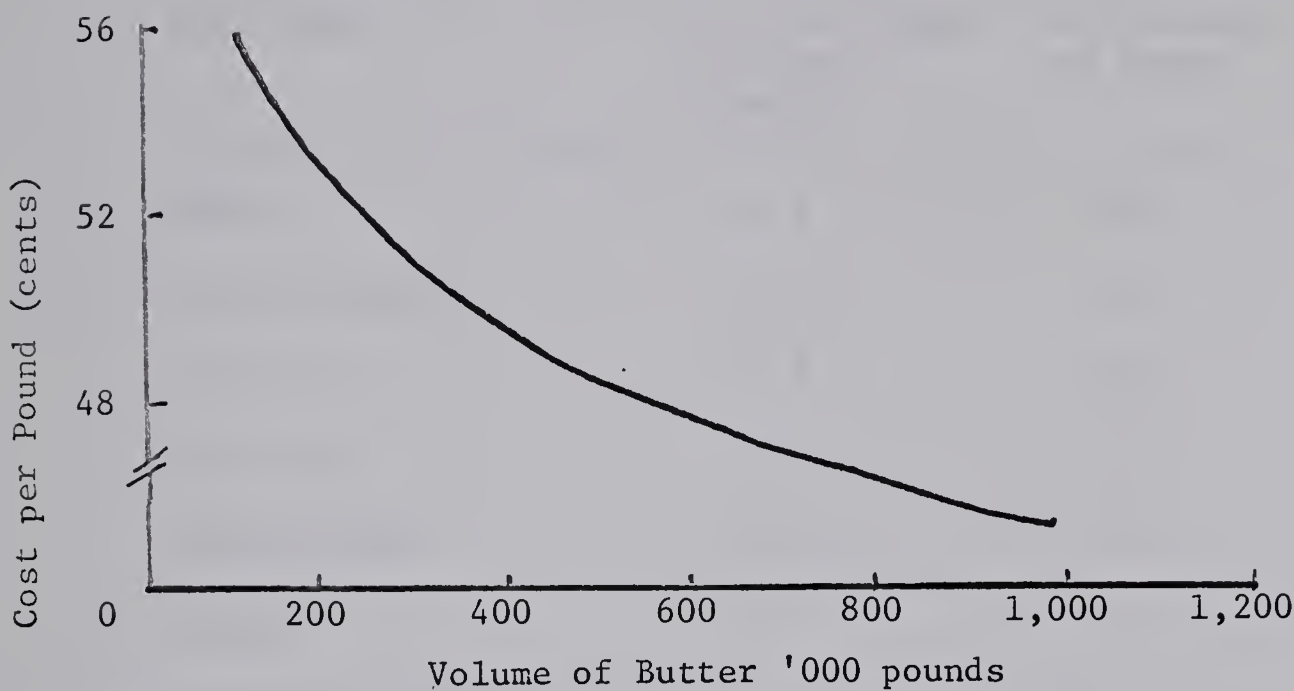
The difference in unit cost for low and high volume operations

is 6.37 cents. This difference in unit cost is substantial. Creameries would be able to spend more money on hauling cream from larger supply areas and make profits. Many smaller plants operate at a loss in their butter operations. This loss is usually offset by another activity. In multiproduct plants labor is usually shifted to the milk or cheese departments. This, however, only partially offsets the losses. Some creameries keep busy with additional printing for others or even buy additional bulk butter to provide an another source of income. Whatever the side activities may be, they do not eliminate the specific losses incurred in the small scale buttermaking operations. Although the lowest volume range indicated losses, it is doubtful if the next category of plants will be able to operate with a profit very much longer, for the production of cream has been continually declining during the past six years.

A study mentioned in the literature review suggested that factors of distance and quality might be limiting the relative importance of larger butter plants. In this study it became clear that larger volumes of cream could be obtained by going farther afield for cream supplies. The effects of time and transportation on cream might well be reflected in the slightly lower prices paid for butterfat by the larger creameries. Column (1) in Table 24 indicates a slightly lower price paid for the butterfat by the larger volume operations--aconsequence of reduced quality. Nevertheless, increased volume provides a potential for larger profits to the creameries. Larger volume of product per plant suggests substantial reduction in the per unit cost for any of the plant sizes considered. (Figure 14).

FIGURE 14

AVERAGE TOTAL COST PER POUND OF BUTTER IN RELATION TO PLANT SIZE FOR ALBERTA CREAMERIES, 1965



Source: Creamery Survey, 1966

The three highest cost items for manufacturing butter are wages, administration, and supplies. These items constitute 35, 24, and 16 percent of the total cost, respectively. Together these items comprise 75 percent of the total cost (Table 25).

Wages comprise 35 percent of the total cost and are very closely related to the volume of production per plant. When cream receipts are very low during winter months, the unit cost of making butter is very high (Figure 15).

The variation in wages is greater for smaller plants than larger ones. Plants producing between 200,000 - 400,000 pounds of butter had a variation of over two dollars per 100 pounds of butter in their wage costs, while the variation for plants producing over 800,000 pounds of

TABLE 25

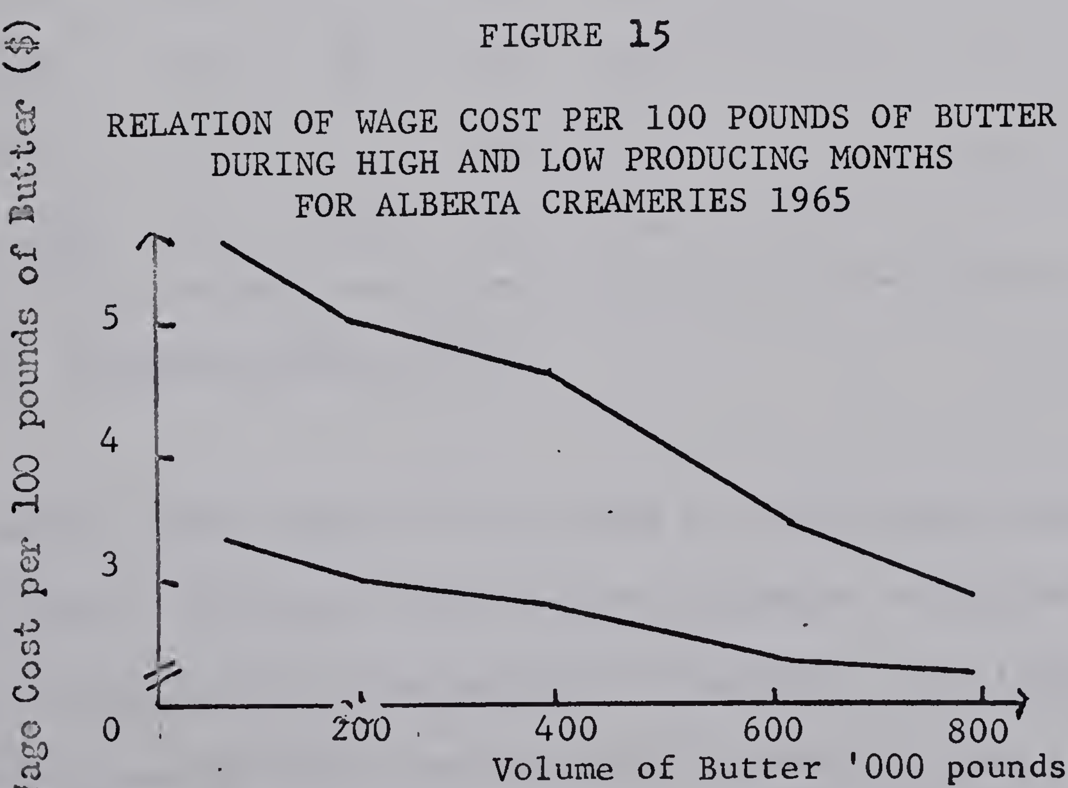
MANUFACTURING COSTS PER POUND OF BUTTER IN 42 ALBERTA CREAMERIES, 1965

Cost Items	Cost per Pound of Butter (cents)	Percentage of Costs
Wages	17.2	35
Administration	11.8	24
Supplies	7.8	16
Utilities	3.9	8
Depreciation	3.9	8
Repair	3.5	7
Insurance and Taxes	1.0	2
Total	49.1	100

Source: Creamery Survey, 1966.

FIGURE 15

RELATION OF WAGE COST PER 100 POUNDS OF BUTTER DURING HIGH AND LOW PRODUCING MONTHS FOR ALBERTA CREAMERIES 1965



Source: Creamery Survey, 1966.

butter annually was less than one dollar per 100 pounds of butter. Since wage costs are inversely related to the volume of butter handled, it is in the interest of the manufacturer to procure as much cream as possible during the winter months. This is another reason for the active procurement and competitive buying policies of creamery operators.

Seven different cost items of 37 plants were utilized in a breakdown for the various plant sizes (Table 26).

TABLE 26

VARIOUS COST ITEMS OF MANUFACTURING BUTTER IN RELATION TO PLANT SIZE, EXPRESSED AS PERCENTAGE OF TOTAL COST, ALBERTA CREAMERIES, 1965

Size of Plant '000 lbs. Butter	No. of Plants	Wages	Administration	Supplies	Utilities	Insur. and Taxes	Bldg. and Equip. Repairs	Bldg. and Equip. Depreciation
Under 200	4	36	21	8	12	1	8	14
200 - 400	15	37	22	13	10	1	8	9
400 - 600	8	38	25	14	9	3	7	4
600 - 800	7	41	24	14	7	3	4	7
800 - 1,000	3	40	21	16	7	3	6	7

Source: Creamery Survey, 1966.

This summary shows that the cost items on a percentage basis do not differ a great deal. This may imply that the important economics of larger scale must be found in utilization of resources. For instance, all creameries need to hire a buttermaker, but smaller plants use this man

for a dozen other jobs besides buttermaking.

Capital Turnover

Capital turnover refers to the time required for gross operating revenue to equal total investment. The higher a year's production compared to the investment, the better will be the chances for obtaining a higher income. Slow rates of capital turnover may be due to over-investment in building and equipment or low production. More intensive use of equipment strongly affects the capital turnover. Low producing creameries have a slow turnover of capital compared to the larger volume plants (Table 27).

TABLE 27

RELATION OF CAPITAL TURNOVER TO SIZE OF PLANTS, ALBERTA CREAMERIES, 1965

Size of Plant Pounds of Butter	Turnover of Capital per Year
Less than 200,000	3
200,001 - 400,000	9
400,001 - 600,000	13
600,001 - 800,000	11
800,001 - 1,000,000	14
1,000,001 and up	11

Source: Creamery Survey, 1966.

Overinvestment in equipment is general for Alberta creameries. In 1965 low and high producing plants utilized 23 and 84 percent of their equipment capacity, respectively, during the month of June.

One way of adapting plant operations to the seasonal fluctuation of cream would be to increase the output by means of the time dimension, since the rate of output is nearly constant for each plant. This implies greater use of overtime, where economically feasible, rather than overinvestment in equipment. Extended day shifts are normal in ice cream and milk plants. Continuous buttermaking and centralized butterprinting equipment are often operated eight to twelve hours per day during the busy season. Typical country plants hardly reach the volume where such conditions are necessary. Thus they are continually subject to low capital turnover.

Transportation of Butter

About 50 percent of Alberta's butter is sold in British Columbia. Transportation rates for long distances depend upon a large number of factors, such as bulkiness, value of product, perishability, and size of shipment. For distances up to 100 miles transportation rates per mile for butter are considerably higher than for longer hauls up to 400 miles (Figure 16).[1]

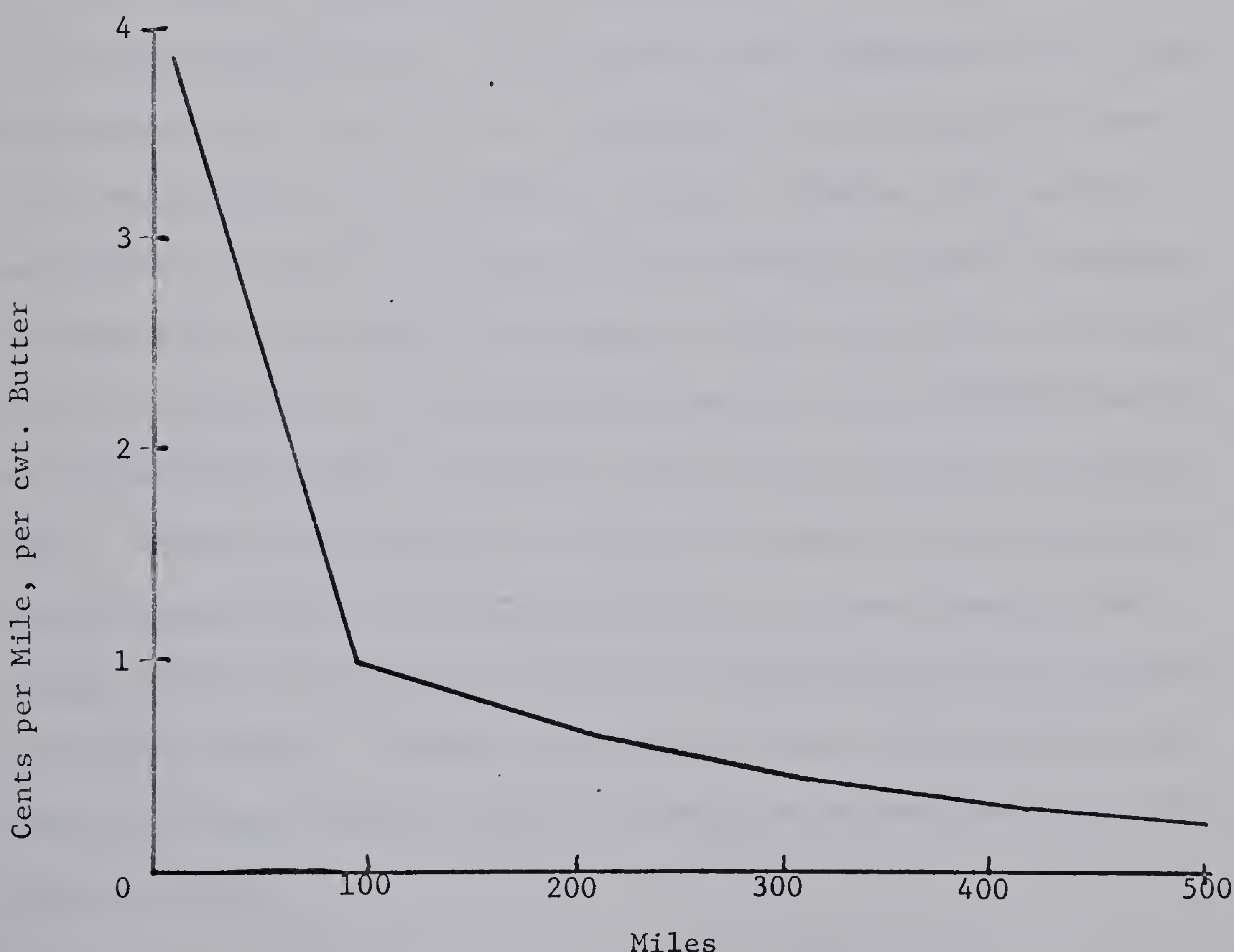
Transportation rates apply only to full carloads which are about 38,000 pounds of butter. Seven firms are selling Alberta butter on

[1] Transportation rates were obtained from a local transfer agency that delivers butter to Vancouver.

the Vancouver market. Utilization of economies of transportation is feasible only for the larger plants. Small factories would require relatively large storage capacities to be able to collect enough butter for a full truckload; such storage space would likely be uneconomic in operation.

FIGURE 16

RELATION BETWEEN UNIT COST AND DISTANCE FOR TRANSPORTATION OF ALBERTA BUTTER,1966



Source: Creamery Survey, 1966

CHAPTER V

SUMMARY AND CONCLUSION

In 1965, 1,719,425,000 pounds of milk were produced in Alberta. Milk is utilized for various purposes. The most important, in quantitative terms, is the conversion of milk into butter. The greatest quantity of milk used for the manufacture of butter occurred in 1925, when 75 percent of the total production was converted into butter. From 1925 on there was a gradual decrease in the percentage of the total milk utilized in butter production. In 1965, for instance, only 52.1 percent became butter.

During the twenties many creameries were built in closer proximity to the cream supply areas. This resulted from elimination of the cream buying stations. The result was improvement in the quality of cream and, consequently, in the quality of butter. However, this movement intensified the competition for cream by creamery operators attempting to improve the cost volume relationship of their operations. Subsequent shifts in the pattern of agricultural production and production methods has gradually resulted in relatively lower cream production in certain areas. Though farm separation of milk was a useful frontier method of providing some food and utilizing otherwise idle labor, specialized farming methods have greatly reduced the production of cream, especially in southern Alberta. Central and Northern Alberta still provide opportunities for small scale diversified farming operations and a continuing supply of cream.

Average output of butter per creamery for the Province has increased from 37,000 pounds of butter in 1910 to 457,000 pounds in 1965. Sixty-five percent of the creameries produce less than 400,000 pounds of butter per year. Several of the low producing plants are local independent dairy operations. Of the 80 butter making operations, there are 31 creameries that specialize in buttermaking only. The other 49 are part of multiproduct plants.

Cooperatively owned plants manufacture 500,000 pounds more butter, on the average per year, than independently operated creameries (p. 36). Advantages of the cooperative movement lie mainly in securing larger cream supply areas, reduction of transportation costs and price competition, centralized buying of supplies and printing of butter, and utilization of the Vancouver butter market. Financial benefits have been passed on to producers and stimulated the continuation of cream production in the areas of the co-ops.

In the southern part of the Province, especially A.R.A. 3, there are still several low producing independently operated creameries. The dairy industry originally started in this area. Consequently, a shift in agricultural production--favourable for other products--resulted in lower cream production in the south. The long established individual creamery operations could not readily adjust to changing production conditions.

A cross-sectional view of creameries in the province aids in pointing out areas of potential profit as well as areas of difficulty in creamery operations. Not only were older buildings and equipment and underutilization of machinery and labor a problem, but the difficulty of securing sufficient quantities of cream for economically sound and

profitable operations also seemed a major dilemma. Creamery operators competed for cream by using various services: sharing of transportation costs, buying of supplies, and competing on prices in order to maintain, rather than to extend, their cream supply areas.

The problem of creameries may also be viewed as the existence of an overabundance of creameries competing for the present small volume of cream forthcoming from producers. This view is justified by the fact that a great potential for profit exists if creamery operators could spend more on cream hauling in order to improve present operations.

Plant costs vary substantially between low and high volume creameries. Considering unit costs of manufacturing butter, it was found that low volume plants pay 6.37 cents more than high volume plants to manufacture one pound of butter. Wages constitute an important part of manufacturing costs. On the average wages and administration costs account for 59 percent of the costs. There is a strong influence of seasonal production patterns so unit costs fluctuate considerably over the full year period. The savings associated with increased volume may be available for even larger operations than the present high volume creameries that exist in the province.

The two large dairy cooperatives in central and northern Alberta are well established and organized. Substantial savings are available through quantity discounts in buying supplies and the centralized printing of butter. These organizations are presently planning to further reduce the number of branch plants. There are also plans for reorganization of something similar to cream buying stations. Several creameries could be utilized as collecting and storage stations for

cream. Bulk tank transportation would then be a very economical way of transferring cream to larger manufacturing sites.

Amalgamation or merging of individual dairy enterprises into larger plants is done extensively now, and with great success, in major dairy regions and countries. Similar action is possible for several creameries in southern Alberta. On the basis of the evidence of cost-volume relationships creamery operators can permit to spend more on procurement costs, that is to go farther afield for cream as a consequence of amalgamation and still receive additional monetary returns because of the increased volume in their operations.

APPENDIX I

TABLE 1

CASH INCOME FROM THE SALE OF FARM PRODUCTS AND SUPPLEMENTARY PAYMENTS*

	Percent
Wheat	34.2
Cattle	25.3
Hogs	10.5
Coarse grains	9.9
Other field crops	7.0
Dairy	6.8
Poultry	4.0
Other livestock	1.6
Supplement payments	0.7
	100.0

*Alberta Department of Agriculture, Statistics of Agriculture for Alberta 1963 and 1964, Publication No. 121.

TABLE 2

CASH INCOME FROM THE SALE OF FARM PRODUCTS AND SUPPLEMENTARY PAYMENTS*

		1964
Total Crops		$313,328,000
Cattle and calves	$153,299,000	
Hogs	63,624,000	
Sheep and lambs	2,933,000	
Dairy products	41,364,000	
Poultry products	24,235,000	
Other livestock products	6,460,000	
Total livestock and products		291,915,000
Total cash income		$605,243,000

*Alberta Department of Agriculture, Statistics of Agriculture for Alberta, Publication 121.

TABLE 3

ESTIMATED FARM VALUE OF ALBERTA MILK PRODUCTION 1965

	Pounds '000	Milk Equiv. '000 Pounds	Percent Total Milk	Price	Value '000 $
Butterfat for Creamery Butter	29,615	855,551	52.1	.668/lb.**	19,793
Farm Dairy Butter	1,139	26,653	1.6	.56/lb.	638
Milk and Butterfat for Ice Cream (milk basis)*		31,789	2.0	2.87/100 lbs.	913
Milk for Cheesemaking and Concentrating		128,581	7.8	2.81/100 lbs.	3,617
Fluid Milk Sales		290,879	17.7	4.83/100 lbs.	14,055
Cream Fluid Sales (milk basis)		70,498	4.3	2.85/100 lbs.	2,012
Milk Farm Home Consumed		142,900	8.7	2.77/100 lbs.	3,958
Fed Farm Animals		94,370	5.8	2.77/100 lbs.	2,614
Kept on Farms, Skimmilk	764,783			.48/100 lbs.	3.671
Total		1,641,221	100.0		51,271

* Does not include butterfat from creamery butter used in the manufacture of ice cream.

**Includes government subsidy, but not supplemental payment.

TABLE 4

ESTIMATED PRODUCTION AND VALUE OF FACTORY DAIRY PRODUCTS 1965

	Quantity '000	Price	Value '000 $
Creamery Butter, lbs.	36,562	.5493/lb.	20,084
Cheddar Cheese, lbs. (including net increase in processing)	2,188	.4213/lb.	922
Ice Cream, gallons*	5,246	1.45/gallon	7,607
Fluid Milk Sales, lbs. (including processing charges)	290,879	6.49/100 lbs.	18,878
Cream as Milk, lbs. (including processing charges)	70,498	4.51/100 lbs.	3,179
Skimmilk and Buttermilk Sales for Human Consumption (including processing charges)	23,377	3.83/100 lbs.	895
Skimmilk, Buttermilk, lbs.	44,240	.48/100 lbs.	212
Whey, lbs.	18,581	.24/100 lbs.	45
Miscellaneous Manufactured Products**			7,615
Total			59,437

* Includes hard and soft ice cream.

** Includes concentrated milk products, cottage cheese, whey butter, cheese other than cheddar and yoghurt.

TABLE 5

CREAM RECEIPTS ON A MONTHLY BASIS*

Month	Percentage of Yearly Total			
	1964	1963	1962	1961
January	5.6	5.1	5.9	5.1
February	5.9	5.6	6.4	5.6
March	6.7	6.3	7.1	6.7
April	8.3	7.7	8.3	8.3
May	10.2	10.0	10.3	10.0
June	12.3	12.7	12.8	12.6
July	12.2	12.5	12.4	12.6
August	11.2	11.3	11.0	11.3
September	9.4	9.7	8.9	9.3
October	7.3	7.9	7.0	7.3
November	5.8	5.8	5.2	5.8
December	5.1	5.4	4.7	5.4
Year	100.0	100.0	100.0	100.0

*Alberta Department of Agriculture, Dairy Branch, Annual Report.

TABLE 6

GRADES OF CREAM RECEIVED AT CREAMERIES

Year	Table Cream	Special Grade	First Grade	Second Grade	Off Grade
		- percentage in each grade -			
1922	2.3	32.4	37.3	27.2	.8
1925	1.7	39.0	47.1	12.0	.3
1930	3.2	43.9	45.9	6.6	.4
1935	2.9	61.3	31.3	4.3	.2
1940	3.0	66.4	28.0	2.4	.2
1945	1.0	54.2	39.9	4.7	.2
1950	1.1	56.3	39.4	2.9	.3
1955	1.1	54.4	42.6	1.9	.1
1960	1.3	56.3	40.9	1.4	.1
1961	1.2	57.6	39.6	1.5	.1
1962	0.9	57.0	40.6	1.5	.0
1963	0.8	54.9	42.6	1.6	.1
1964	0.7	57.9	40.0	1.4	.0
1965	0.5	60.3	37.9	1.3	.0

Source: Alberta, Dairy Branch Statistics, 1965.

TABLE 7

PRODUCTION AND VALUE OF CREAMERY BUTTER*

Year	Creameries	Production '000 lbs.	Av. Output Per Cream. '000 lbs.	Selling Value	
				Total '000 $	Cents per lb.
1906	42	1,960	47	416	21.21
1910	60	2,238	37	575	25.69
1915	57	7,544	132	2,021	26.79
1920	53	11,821	223	6,556	55.45
1925	99	19,630	198	6,959	35.45
1930	92	17,717	192	4,968	28.04
1935	97	23,095	238	4,589	19.90
1940	95	29,797	314	6,651	22.32
1945	91	34,693	381	11,390	32.83
1950	92	31,238	340	16,809	53.81
1955	89	31,326	352	18,041	57.59
1960	86	37,338	434	23,265	62.31
1961	86	40,917	476	25,414	62.11
1962	86	38,934	453	24,365	62.58
1963	85	38,467	453	20,572	53.48
1964	82	39,824	486	20,900	52.48
1965	80	36,562	457	20,084	54.93

*Alberta Department of Agriculture, Dairy Branch, Annual Report.

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